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POWER

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ELY C. HUTCHINSON, *Editor*

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Pull

AT A TIME like this the dominant thought in the minds of so many regarding the lack of opportunity to earn a living finds expression in letters to the editor.

One of the complaints is against the "pull" which lands competitors in jobs while merit fails of advancement or is unable to obtain employment.

The administrators of the primal curse are accused of favoritism in its imposition. Opportunities for earning a living by the sweat of one's brow are at a premium.

In many cases this cry of "pull" is an alibi for lack of success, but the wail is too often justified.

The gate of opportunity is opened to people by reason of their kinship or friendship with those in authority. Minor officials give out appointments for a consideration or because the appointee is a relative, a friend, a member of one's church or lodge.

What are the considerations that should govern the decision of him whose business it is to choose? What would determine you if you were the one to make the selection?

Fitness for the job may, to the man who must make this decision, mean more than present capacity to turn out production.

As against vigorous youth with all the possibilities of the future before it would you consider seniority, years of faithful service and warranted expectation of advance?

Would you give specially favorable consideration to a candidate because he needed the job more than any of the others? Would you favor a man with a sunny disposition and the knack of making himself agreeable and useful over a manifest trouble maker with a perennial grouch?

If one of the applicants seemed to be possessed of exceptional intelligence with language, manners, appearance, personality such as to indicate a "comer" who would probably walk through this job on and up and be a valuable addition to the personnel would you be inclined to favor him over mediocrities who got there first and thought they had a better claim on the workings?

Some people have the front and faculty to create that sort of favorable impression whether or not they have the indicated qualifications. The real worth of others is hidden because they do not look the part or know how to make it evident.

And one of the hardest of things is to make mediocrity see why it will not do.

There is doubtless much of favoritism or worse in the awarding of opportunities, but all is not "pull" that seems. So the unsuccessful candidate should look inward and be not too hasty to lay the blame elsewhere.

F. R. Low

DETROIT PUBLIC

EDITORIALS

Public Utilities and Commodity Prices

BY WHATEVER CIRCUMSTANCE, through whatever influence—political, economic, national or international—there is no doubt that the world is indulging itself in the luxury of industrial hesitation. Meanwhile, the interim preceding the return of buyer's confidence is being energetically used by the far-seeing to re-equip for keener competition, the certainty of which seems assured.

This in itself, presages an era of lower prices and presents problems which industry must successfully solve if there is to be anything better than another period of profitless prosperity. Industry must turn to the development of methods by which its products can be sold at lower prices without sacrifice to profits or curtailment of average buying power among the workers. Obviously, the only way to do this is to reduce the cost of manufacture without sacrificing quality.

It is equally obvious that the responsibility rests, not with any single industry, but with all. Each must contribute its bit. The economics of each situation will determine how.

Probably no other item enters into the cost of all products, as does power. To be sure, it may be in varying proportion to the total, but it is always needed. For this reason it is a principal factor with a major influence, and if some way can be found to reduce its cost, without sacrificing the industry itself, a boon will be conferred upon the general welfare.

Great strides have been made in station economy and generating costs are improving. Operating expenses are subject to strictest scrutiny. Research is going ahead in every direction bearing upon the elimination of expenses arising from imperfect knowledge of the art. Yet, there is a line of attack which seemingly has not had the attention it deserves.

Since many of the utilities have admittedly reached the point where extensions into new territory cost more than the newly acquired load will pay, why not leave that territory for development by some other more economical means and concentrate effort upon the intensive development of territory within an economic radius. The increase of load within a concentrated area will reduce the cost per power unit and ultimately make possible the legitimate reduction of rate which will so help industry as a whole.

The outlying community or industry, when left to its own devices, will build up to the point where it can be economically taken into the utility system. If it does not, it should not be absorbed to become a burden to the ratepayers within the economic distribution zone. While some such plan may involve modification of existing policy, it should result in a stimulation of activity, thus directly benefiting business at large and increasing the profitable business of the utility.

Planning New Power Plants

PLANNING a new power plant calls for more than ordinary astuteness on the part of designing engineers. Too often attention is so completely concentrated on problems of contemporary importance, that the new plant follows the lines of current practice without adequate provision for advances in the art. Later on, changes in practice may make it desirable to add quite different equipment from that which was originally conceived, and in many cases it is found that such additions can be made only at some sacrifice of operating convenience and without attaining the over-all efficiency that would otherwise have been possible.

For instance, a large central station was originally planned with the idea that only moderate ratings would be carried on the boilers. Later developments in the operation of large boilers at high ratings made it desirable to revise the original plans of this particular station. Much larger turbine-generators are now being added

than were originally intended while the same size of boilers was retained but with furnaces built to operate at higher ratings.

In another case, the size of turbine-generators was selected for the ultimate station, having in mind certain advantages of standardized equipment. Later on, increased loads and improvements in steam-turbine design made the use of larger units desirable when the station was only half completed. Limitations in the original design of condenser cooling-water tunnels have prevented the realization of the full possibilities of the new equipment.

Again, conservatism in the selection of steam pressures and temperatures has often imposed limitations, the correction of which is found in the addition of high-pressure sections to many comparatively new plants.

Therefore, in planning a new station one must look ahead and consider the probable state of the art when the plant is to be completed. Boldness in choice of operating conditions and foresight to determine what the future conditions of operation will be, are characteristics that the power-plant designer must possess if his new plant is not to be out of date before it is fully equipped.

Co-operation of Management

THAT EFFICIENT OPERATION of power plants requires the whole-hearted co-operation of the entire operating staff, from the fireman up, is axiomatic. At the same time, it is equally important that management co-operate with those who have the plant's operation in charge.

If maximum efficiency is to be obtained, the operator must be given proper tools to work with, and his most important tools for this purpose are instruments. With them he can find and stop heat losses; without them he must operate in the dark. Given plant efficiency figures calculated from instrument data he can see the result of his efforts and judge the effect of changes in operating methods.

Ease of operation is another tool which, if incorporated in the plant, will be of great assistance to the operator in his endeavor to attain maximum efficiency. Much can be gained in this direction if he is consulted when the purchase of new equipment or changes of design are considered. Management co-operates when it provides these aids to operation.

A rundown plant cannot be expected to produce power as cheaply as one in good repair. First, because poorly maintained equipment loses its efficiency and secondly, because operating morale is soon broken. Management co-operates when it employs a maintenance crew, and provides opportunity for repairs.

If management co-operates fully with the plant operating staff, it need not worry about the operator's co-operation for this will follow as a natural sequence.

Science Pays Another Cash Dividend

STOCKS may go up or down but pure science keeps in the lead as a source of cash dividends. No better long-run investment of time and money has ever been discovered. And the fun of the thing—of which there is plenty—is all velvet.

"Metal Week," recently held in Chicago and reported in this issue, showed again how knowledge, originally obtained purely to assuage man's insatiable curiosity, is turning into gold before his eyes.

Years ago, some delving chemist discovered the rare metal "chromium"—interesting, costly and useless. Somebody else found that it was very hard. Starting two or three years ago, chromium plating swept the commercial field. Now "Metal Week" brings the announcement of a new cast iron. Nickel, copper and chromium in suitable proportions give it unique resistance to corrosion and heat properties that will find ready application in many fields, particularly the power field.

X-rays and radium, strange playthings of scientists, found early application in medical practice for diagnosis and treatment. More recently X-rays have been used to make shadow pictures, or "radiographs," of metal parts to detect flaws. Metal week revealed a new field for the radium capsule as an extremely convenient source of rays for these shadow photographs. It also made public a new application of X-rays, not simple shadow pictures, but X-ray "spectra patterns" that tell how the minute crystals in the metal are arranged.

This very practical application is a direct outgrowth of the purest of pure research—investigation of the structure of atoms through their action on the extremely short X-ray waves.

Many of the typical papers presented during metal week used mathematical, chemical and physical methods to derive results of direct commercial value. These highly developed tools of man's thought would not be available were it not for centuries of purely scientific work.

These are typical examples of the rule that scientific knowledge will somehow find a way to be useful, and to pay many times for the original effort spent in securing it.

▼

POWER *Stands for . .*

1. Making Power When It Should Be Made
2. Buying Power When It Should Be Bought
3. Cheaper Power Through Modern Equipment
4. Easier Financing of Equipment Purchases
5. Better Use of Byproduct Heat and Power
6. Operating Methods That Save Money
7. Less Waste in Transmission and Application
8. Prevention of Smoke, Within Reason

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SCIENTIFIC CONTROL in WELDING of BOILER DRUMS

Precision and organized method are necessary precedents to the acceptance of fusion welding for boiler drums—The account of a visit to the Barberton works of the Babcock & Wilcox Co., by the author.

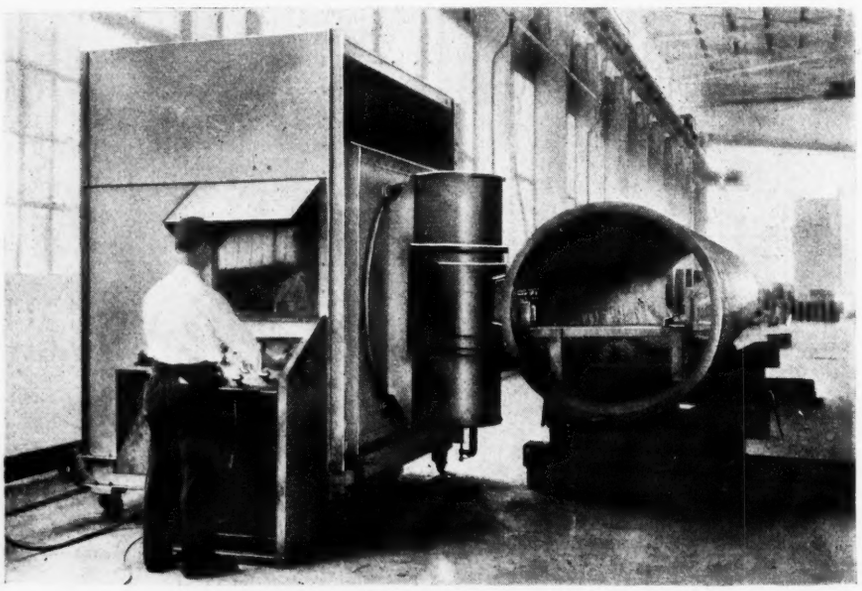
By ELY C. HUTCHINSON
Editor of POWER

THOSE people to whom the production of power is a life work, are continually alert to the trend of boiler design. They watch closely the developments both at home and abroad and are very quick to turn a thought or suggestion, wherever received, to the benefit of the work in which they are engaged. They are aware of the differences of thought existing between the advocates of high pressures with comparatively low temperatures and the proponents of moderate pressures with high temperatures. There are advantages pro and con and each school can point to successful examples in existing plants, all of which are a tribute to the best engineering thought of the time. With all this it is, nevertheless, quite human to accept the existence of the equipment in the plants with little consideration of the evolution of manufacturing methods which has made it possible.

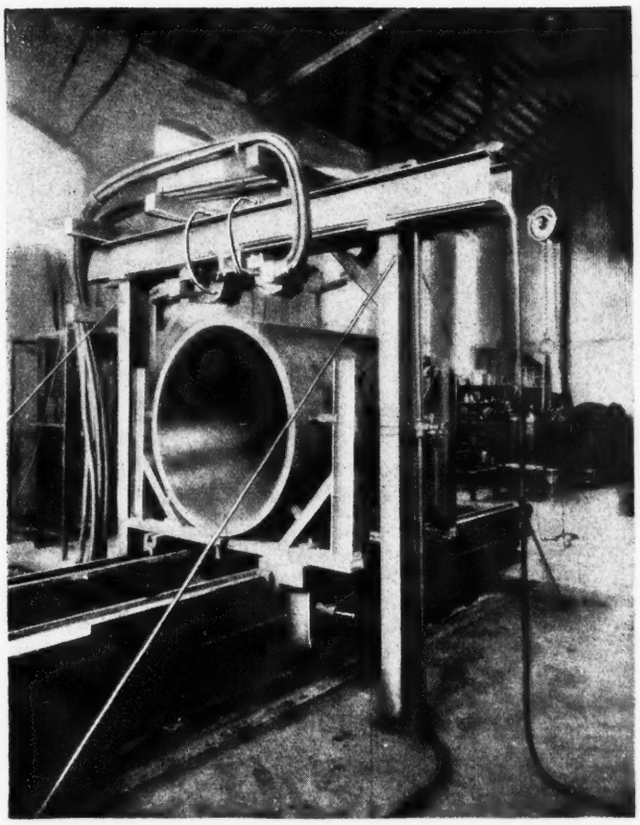
Take, for instance, the case of boiler manufacture. The demands upon modern boilers in such matters as pressure, temperature, capacity and ability to operate at continuous overload, have required a perfection of the building technique that was unknown a few years ago. A visitor, at the Barberton plant of the Babcock & Wilcox Company, is aware of the complete disappearance of the traditional boiler shop of the late nineties. In its place has come the scientific approach, the precision, accuracy and systematic control one would hardly expect to see outside of a strictly high grade, modern machine shop. Rule of thumb methods are obviously absent. The demands of present-day boiler construction and operation require a system of inspection and a rigid discipline of product control reaching from the laboratory of scientific metallurgical research through the experimental department and into the physical laboratories and shops.

For a good many years it has been the hope and expectation that fusion welding would find a place in the manufacture of pressure vessels, of the fired as well as the unfired type. Practically everyone familiar with the subject is aware of the difficulties that have been met along the road to this objective. The ordinary hand methods of welding, with their dependence upon the skill of the individual, have admittedly been too unreliable for economical use in the construction of boilers or other pressure vessels.

With the advent of welding machines one important element of the problem was solved. Others of greater



X-ray apparatus for photographing weld seams. Electrical equipment and the tubes are enclosed in the portable housing, the movement of which is guided by the rail at the lower left hand corner



Sperry electro-magnetic flaw detection apparatus applied to boiler drum weld examination

difficulty have, nevertheless, remained. Without attempting to go into the history of the fusion welding art, it is sufficient to state that there has been general recognition, for a number of years, that eventually a welding technique suitable for the reliable and dependable construction of boiler drums must be developed and put into commercial use. There have been many demands upon the Boiler Code Committee of the American Society of Mechanical Engineers for a revision which would permit the adaptation of fusion-welded construction to boilers and other pressure vessels without such rigid restrictions as are at present in force. The Boiler Code Committee, while recognizing good work already done, has consistently taken the position of willingness to admit the use of fusion welding just as soon as it has been demonstrated to have qualities that are comparable with the present materials of boiler construction and that the ability to produce these qualities uniformly and dependably has been successfully demonstrated. To meet these requirements the utmost is demanded of those engaged in boiler manufacture or allied with it.

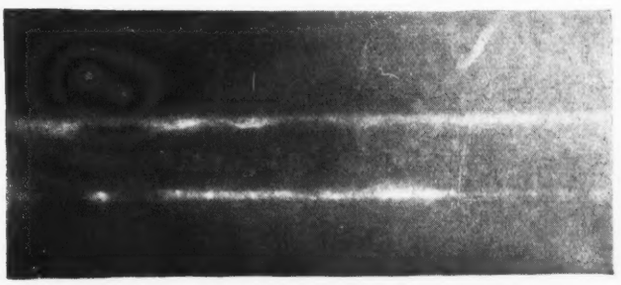
The Babcock & Wilcox Company, after five years of intensive scientific research and experiment in consultation with some of the foremost scientists of the country, has arrived at the point where it has been possible to establish a definite regimen for the manufacture of boiler drums by the fusion welding process. The work they have done is a distinct contribution to the art and as such it should be of great interest to the readers of *Power*.

Welding machines of special construction are used and it is characteristic of the process that the groove in which the electrode metal is deposited shall be quite narrow as compared with the other processes. A coated electrode is used with the result that, as its metal is deposited, it is virtually surrounded by a protective crater of slag which effectively prevents oxidation. On completion of the bead a very slight hammer blow cracks the slag coating and an air blast clears it away completely, revealing the metal of the weld as a bright, clean deposit which has fused into the walls of the weld channel in the form of a concave meniscus. Successive beads laid one upon the other have the effect of annealing the ones previously laid. Upon completion of the weld the entire vessel is subjected to a strain relief treatment at approximately 1,200 deg. F.

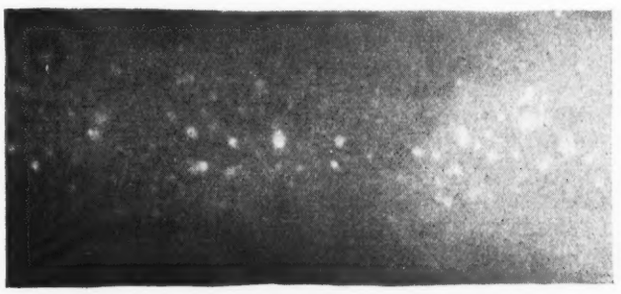
Although the technique is such that the metal deposited in the welded seam is of assured quality, tensile tests are made regularly to prove each joint.

The quality of the welds to determine dependability is examined by two methods. First, X-ray photographs are taken of the entire welded joint. As at present equipped, each photograph is 12 in. in length and the set-up is such that with one machine, ten photographs per hour are made. By this system the weld is traversed from end to end. Air pockets, slag inclusions, defective fusion to the body metal, and other faults of a similar nature are readily detected. The series of three X-ray photographs accompanying this article will illustrate this.

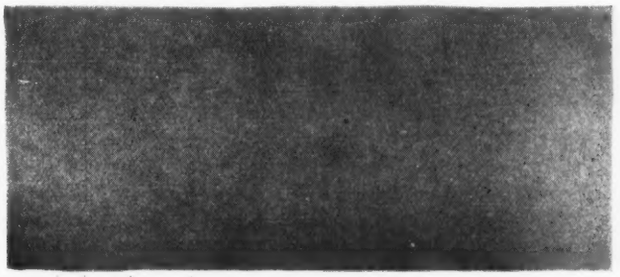
While the X-ray method is very effective in the detection of the most likely faults, it will not detect air pockets or blisters which are almost in contact with each other and are of the full width of the film itself. Obviously



X-ray photograph of a weld showing defective fusion with the metal of the adjoining plates. Close examination will also show the spotted appearance in the strip of welded metal. Although this indicates some lack of density, the amount is insufficient to cause rejection



X-ray photograph showing perfect fusion between the weld material and the adjoining plates, also some moderate defects in the strip of welded metal. This characteristic would cause doubt as to the quality of the weld



X-ray photograph showing perfect weld metal and fusion with adjoining plates. This is an excellent specimen

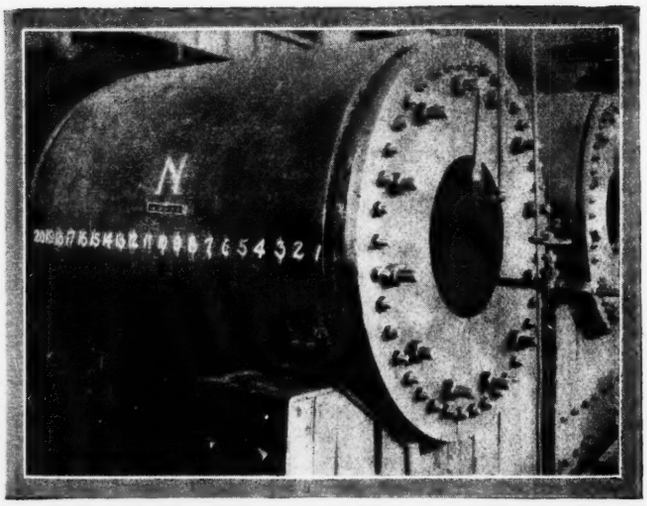
a condition of this kind would produce too broad a difference in ray filtration through the weld to show the flaw. To eliminate any question of dependability that may result from this characteristic of the X-ray method, each weld is subjected to a second test with Sperry electro-magnetic equipment quite similar to that used for the detection of defective railway rails. Electric current passed through the weld, produces a magnetic field, the intensity of which varies with the presence of defects in the material under test. These variations are picked up by a balanced magnetic coil and transmitted to a recording apparatus which draws a graph representing the quality of the weld. The results of the electro-magnetic test are compared with the X-ray photographs and the combination gives a dependable indication of the physical condition of the joint.

Another question that is always foremost in the minds of those considering the use of welded joints for pressure vessels, is the ability of the weld and the metal of the shell on either side of it to withstand fatigue, for it is known that the body of the metal adjacent to the weld and for some distance away, undergoes a molecular readjustment that has on earlier welds proven to be a source of weakness. To investigate this the company makes numerous fatigue tests. In one case specimens were set up in rotating beam machines and subjected to reversed stresses. Similar tests were made upon boiler plate steel for purposes of comparison. The endurance limit of about 30,000 lb. per sq.in. obtained from the weld metal compares favorably with a limit of 28,000 lb. for the boiler plate.

A second method of test is to subject welded drums to repeated pressure applications. Among the numerous specimens, one was subjected to 13,697,400 cycles at a calculated stress of 23,100 lb. per sq.in. without failure. Another withstood more than 10,000,000 cycles at 30,000 lb. per sq.in. The method of test consisted of the alternate introduction of water under pressure and its release by a motor driven mechanism.

To establish a standard of performance for the welded drums, a plate steel drum of A.S.M.E. standard riveted construction is also undergoing the fatigue test. This riveted shell has stood 1,000,000 pulsations at a stress of 16,500 lb. per sq.in. in the metal of the shell and in addition has carried two times the working pressure, or a metal stress of 22,000 lb. for 100,000 pulsations.

The accompanying photographs show quite well the results that have been achieved. They represent the



Welded drum sections undergoing fatigue tests. The numbers on the side are for the identification of measurement points

outcome of five years of intensive study and indicate what, at present, may be expected of welded jobs properly done and systematically controlled.

The physical and chemical characteristics of the weld metal may be averaged as follows:

TENSILE TESTS—Test specimens are made generally in the form indicated by the accompanying photographs. It has ordinarily happened that the welds have proven stronger than the plates they join. To make certain that the fracture shall take place in the welded metal, it has frequently been necessary to weaken the section at that point by drilling holes through it. Fig. — illustrates a case where test specimens were pulled after successively drilling in them, from one to five holes before the weld was sufficiently reduced in section to break in the place desired. The ductility of the welded material is also very well shown by this picture. A typical case averaged from several hundred tests is as follows:

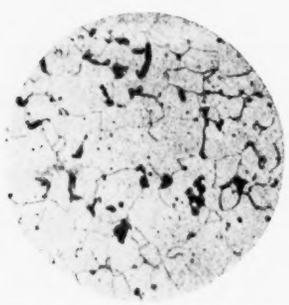
	Min.	Max.	Av.
Ultimate Tensile Strength, Lb. per Sq In.			
Weld metal	65,000	74,500	67,500
Plate metal	55,000	65,000	60,000
Yield Point, Lb. per Sq.In.			
Weld metal	40,000	55,000	45,000
Plate metal	.....	.....	30,000

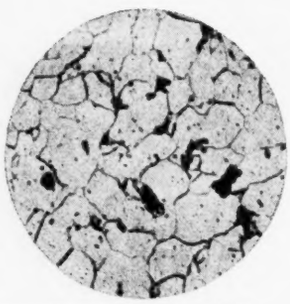
ELONGATION AND REDUCTION OF ARC—The average of several hundred tests taken entirely from the deposited weld metal is:

	Min.	Max.	Av.
Elongation in 2 in. (per cent)	20.5	38.0	28.0
Reduction of area (per cent)	32.0	65.0	40.0

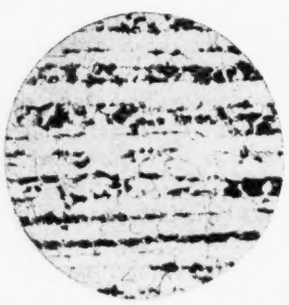
PHOTOMICROGRAPHS TYPICAL OF B & W FUSION WELDED JOINTS

a. Fine grained equi-axed weld metal (100 dia.)

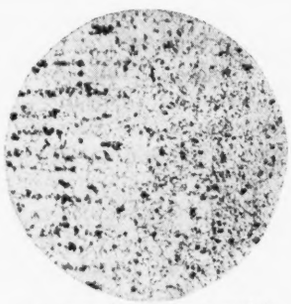




b. & c. Weld metal at higher magnification. No nitrides or oxides (500 dia.)

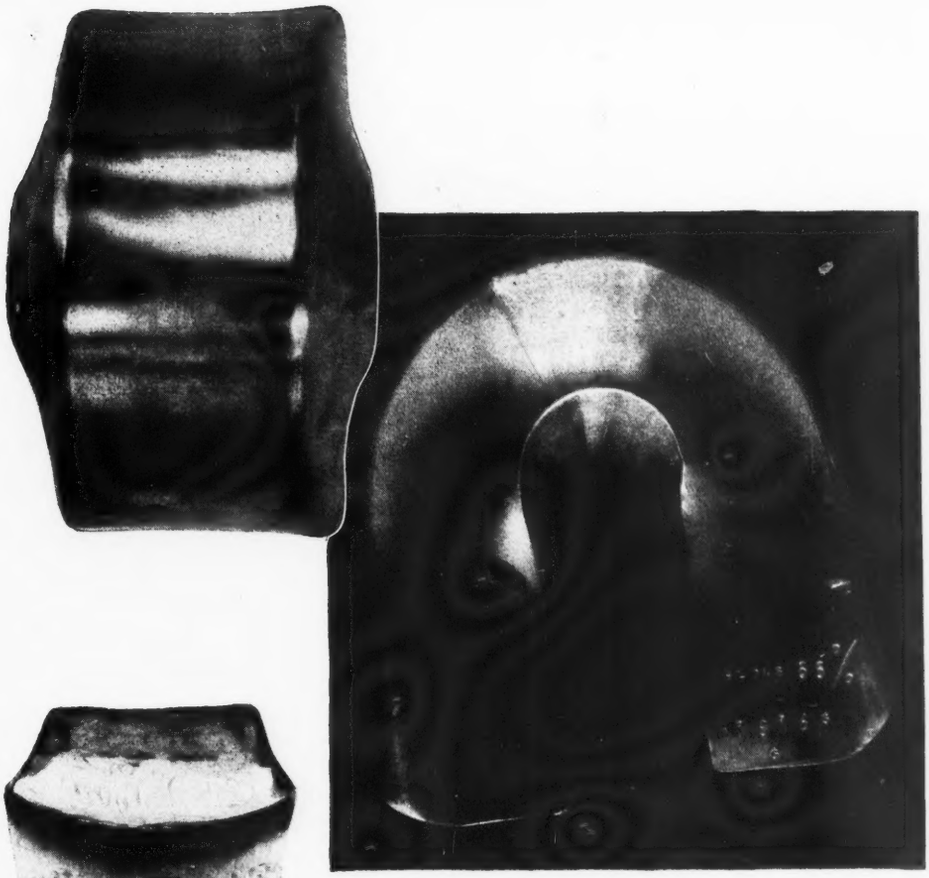


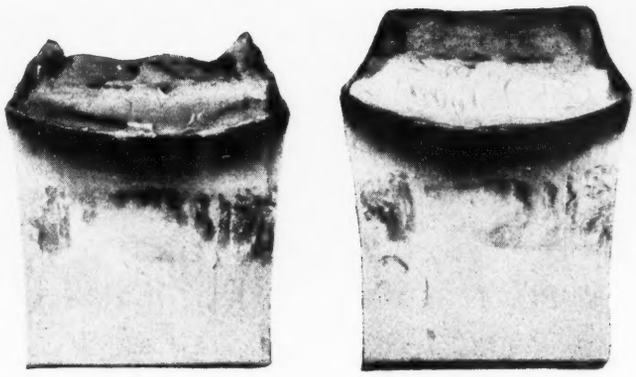
d. Structure of original unaffected plate (100 dia.)



e. Junction of base metal on left and weld metal on right (100 dia.)

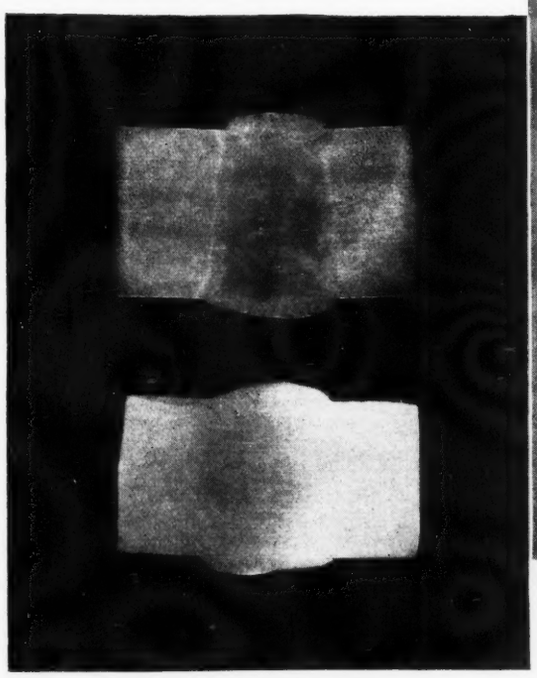
Bend specimen made from 1¾ in. A.S.M.E. firebox plate. The radiating position of the scribed lines shows clearly the elongation of the outer fibers. This specimen showed 55 per cent elongation

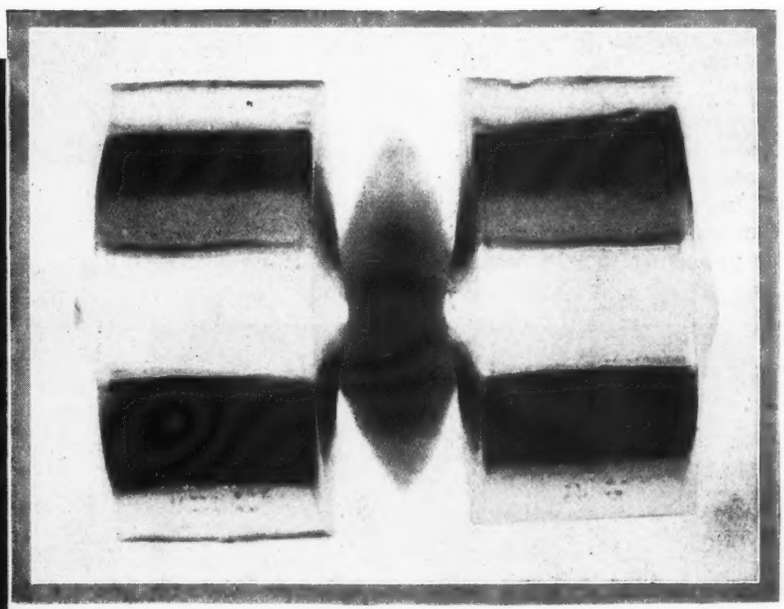




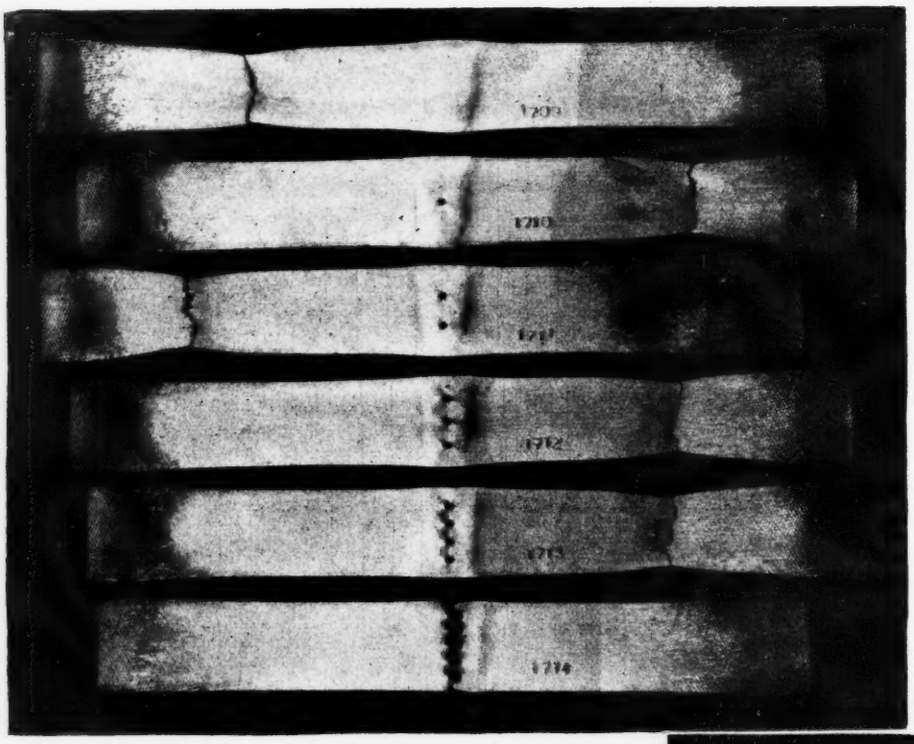
At left, photographs through the weld metal of a fractured bend test specimen showing grain structure

Below, macrographs of a weld, one with polished surface and the other with surface etched





A pair of bend specimens photographed together to show uniformity of the welding results. Comparison of the distance between the scribed lines show this



Tensile test specimens showing consecutive drilling required to produce fracture in the weld metal. The plate material, in this case A.S.M.E. fire box weld metal, developed a tensile strength of 74,200 lb. to the sq.in.

High carbon steel tensile specimens, the plate metal being 70,000 lb. to 80,000 lb. Welds failed at 71,600 lb. to 74,500 lb. per sq.in. Elongation in 2 in. taken across weld 39 to 45 per cent. Yield point of weld metal 46,000 lb. to 48,500 lb.

BEND TESTS—Several specimens of bend tests are illustrated in the accompanying photographs. Numerous cases of this type show an elongation of the outside fibers of 30 per cent to 65 per cent with an average of 45 per cent.

CHARPY IMPACT TESTS—The comparative resistance of the weld metal and A.S.M.E. boiler plate, to spread of a crack or fracture once started, is well shown by impact tests. An average of Charpy impact values by this method is:

	Min.	Max.	Av.
A.S.M.E. boiler plate, ft. lb.	19	33	20
Weld metal, ft. lb.	20	45	28

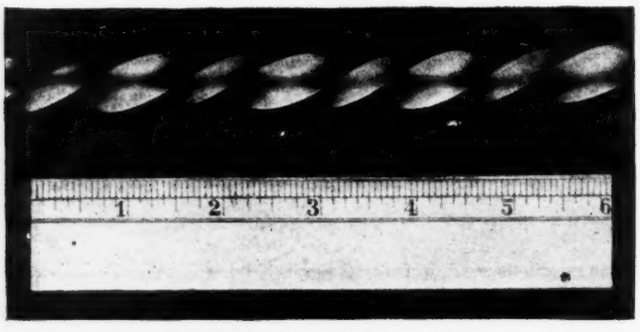
CHEMICAL ANALYSES—Chemical analyses of the weld metal after deposition is compared with ordinary arc weld metal as follows:

	Babcock & Wilcox Weld Metal, Per Cent	Ordinary Arc Weld Metal, Per Cent
Sulphur	Less than 0.04	Less than 0.04
Phosphorus	Less than 0.04	Less than 0.04
Manganese	0.30 to 0.60	Less than 0.20
Carbon	0.08 to 0.15	0.02 to 0.08
Nitrogen	Less than 0.02	0.10 to 0.14

An examination of these figures indicates clearly the value of the slag crater as a superior means of protecting the desirable elements of the weld from atmospheric gases during the process of deposition. A further characteristic of the welding method is apparent in the comparison of density of the weld metal after deposition. This will be seen from the following record of specific gravity:

	Specific Gravity			Per Cent Voids
	Min.	Max.	Av.	
Firebox plate	....	....	7.84	0 plus
Bare electrode weld metal	7.44	7.68	7.59	3.30
Babcock & Wilcox weld metal	7.80	7.85	7.83	0.12

By and large, there can be no question as to the high quality of the material produced nor of the fact that it is possible to make it equal to or better than the metal of the plates it is used to join. In the face of progress such as here exhibited, it cannot be much longer before we may expect welded construction to be put into actual use in the building of boilers.



Specimen of the deposited weld metal twisted through an angle of 120 deg. per in. of length

Characteristics of Materials Used in

HEAT INSULATION

By EUGENE F. ZEINER
Philip Carey Company

This is the second of a series of articles on insulation; the first appeared Sept. 16. It indicates how the materials used in manufacture affect insulating properties

A GENERAL KNOWLEDGE of the characteristics of the raw materials used in making insulation assists in the intelligent selection of the proper type of insulation for any condition. These characteristics determine the conditions under which the material will give maximum satisfaction.

Raw materials used in present-day insulations can be divided into two main classes, organic and inorganic.

Organic materials are of animal or vegetable origin and are not suitable for use at temperatures much above 250 deg., because the decomposition of the animal or vegetable matter, which begins at about that temperature, results in a weakening of the mechanical structure of the insulation. Under favorable circumstances this decomposition may introduce a dangerous fire hazard.

Inorganic materials, on the other hand, are substances not subject to burning out and charring when exposed to continuous heat. It is for this reason that permanent types of heat insulation are composed largely of inorganic substances.

Non-conducting coverings for ordinary (air) temperatures and for refrigeration service, are made of cork, hair, rags or matted vegetable fibres.

Cork is the outer bark of the cork oak, a tree which grows extensively in the countries bordering on the Mediterranean Sea. Spain and Portugal lead the world in the yield of cork. The bark is stripped from the trunk and lower branches of the cork oak tree at regular intervals of about nine years during July and August. Stripping begins when the tree is about 5 in. in diameter. The thickness of the bark ranges from $\frac{1}{2}$ to $2\frac{1}{2}$ inches.

After a few weeks of air seasoning the bark is boiled to loosen up the rough, woody, outside portion of the layer and to remove the tannic acid. The boiling also increases the volume and elasticity of the bark and renders it soft and pliable.

Of particular interest to the engineer responsible for suitable insulation are corkboard and cork pipe covering. In the manufacture of these products granulated cork is pressed in metal moulds and baked at a moderate temperature. Baking liberates the resin in the cork, which cements the granules together, making the use of foreign binding materials unnecessary. As the sections come from the molds they are finished with a coating of mineral rubber to seal them against air and moisture.

These products are used extensively for the insulation of refrigeration rooms and equipment. Cork covering for pipes is furnished in two semi-cylindrical pieces; the joints between the halves are sealed with a waterproof cement and the covering is fastened in place by means of loops of wire.

A type of material, used for many years, with satisfactory results for the insulation of cold temperatures, is felted cattle hair. This hair is secured from the packing houses, cleaned and sterilized, and felted into sheets of various thicknesses.

Hair felt has, in the past, usually been wrapped around pipes and cold containers and bound in place by twine or small metal cables. Modern ingenuity has built hair felt into regular pipe covering sections; air and waterproof baffles have been built in between successive layers of felt and the whole protected by a heavy waterproof armor. This type of hair felt insulation is particularly suitable for refrigeration and ice water lines, because it can be applied in two layers, staggering all joints, thus preventing infiltration of moist air. The value of breaking joints in refrigeration pipe covering is apparent to engineers who have had molded insulation break off their lines because of moisture's penetrating the joints and freezing on the pipes, slowly causing the molded covering to break down. Because of its organic nature, hair felt is not suitable as a permanent insulation on hot lines or surfaces.

Rags and other fibrous materials include a percentage of wool. A fair percentage of wool is necessary to give the felt, into which the rags are made, a soft and porous consistency, a characteristic that is essential for satisfactory insulating value. Wool felt, the name usually applied to this type of covering, is intended primarily for the insulation of cold water pipes where the absorption of heat by the water is to be prevented. For this class of service the covering should have a protective inner liner of waterproof material.

Wool felt covering is occasionally used for the insulation of hot water lines, and for such service an inner liner of asbestos paper is built into the covering to pro-

tect the rag felt from the decomposing effects of heat. Rag felt should never be used for the insulation of pipes or surfaces where the temperature exceeds 250 to 300 deg., because of the deterioration of the structure under heat.

Matted fiber insulations are available for the insulation of ordinary atmospheric temperatures. These materials are constructed by matting together sugar cane, flax, corn stalk, rice plant and similar fibers. The material is subjected to vermin and fire-resistant treatment and is furnished in board or roll form. The most extensive use of such products is perhaps in home building and similar types of construction. Being of vegetable origin, this form of insulation is not suited for high temperatures.

For comparative purposes, the table shows the relative insulating value of these materials.

INSULATING VALUE OF ORGANIC MATERIALS

Material	Weight, Lb. per Cu.Ft.	Thermal Conductivity B.t.u. per Hr. per Sq.Ft. per 1 In. Thick, per Deg. F. Temperature Difference
Cork board	9.75	0.29 to 0.32
Hair felt	16.88	0.247
Wool felt	20.6	0.363 to 0.43
Matted vegetable fiber		
Celotex	16.45	0.33
Linofelt	11.24	0.299
Flaxlinum	11.24	0.328

It follows that permanent insulation of hot surfaces having temperatures above 250 deg. must be composed of materials of inorganic origin and that are not affected by heat within the temperature range for which the particular type of insulation is recommended. Raw materials entering into the construction of present-day heat insulation are: asbestos fiber, magnesia, diatomite, clays, heat-resistant adhesives and organic binders.

An important requirement of practical heat insulations is mechanical strength to provide against excessive breakage. The basic materials depended upon to give insulating value lack natural cohesiveness in some cases and under certain circumstances. To provide suitable strength, some sort of bonding material is necessary. Asbestos fiber is almost universally used for this purpose.

Asbestos is a fibrous mineral distributed extensively throughout the world, but its chief sources for the manufacture of pipe covering are Canada and South Africa. It occurs in veins or strata, the fibers being arranged perpendicular to the wall of the vein. The fiber is separated from the rock by crushing. Further crushing separates the fibrous mass, and the grades are sorted as to length, usually by air suction.

Canadian fiber, generally used in the manufacture of insulating products in this country, is white or greenish-gray. It may be interesting to note that the diameter of the asbestos fiber is about 1/500,000 in., that is about 1/100 the diameter of cotton fiber. Fibers vary from about $\frac{1}{8}$ to 5 or 6 in. in length.

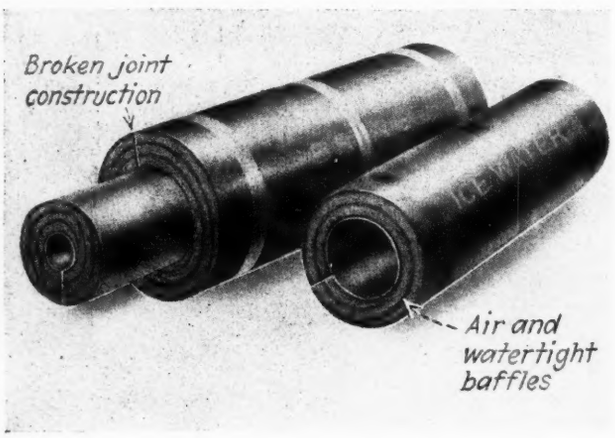
African asbestos is blue, brown or white. The brown is of little use in insulating materials, as it is too brittle and too long; the blue contains too much dust for spinning, but is stronger than the white and makes an excellent binder in molded insulation, such as 85 percent magnesia; the white is equal in every respect to the white Canadian.

The most important property of asbestos is its ability to maintain the fibrous state and its physical strength when subjected to high temperatures. Asbestos is a crystallite formation and therefore contains water of crystallization. The higher that content the better the physical strength and flexibility of the fiber. The crysotile family, to which the Canadian fiber belongs, contains from 10 percent to 15 percent combined water. The crocidolite family, to which the African fiber belongs, contains from 4 percent to 10 percent water of crystallization. It has been definitely established that as the asbestos fiber loses its water of crystallization it simultaneously loses its physical strength.

Investigators do not seem to agree as to the temperatures at which crude asbestos fiber loses its water of crystallization. The following temperatures are given as a general indication of the effect of heat on asbestos fiber:

Crysotile fiber begins to lose water of crystallization and strength at approximately 842 deg., and at 1,472 deg. it is completely gone. Crocidolite fiber begins to lose water of crystallization and strength at approximately 572 deg., and at 1,112 deg. it is completely gone.

From these figures it can be seen that physcial strength in insulating materials cannot be secured entirely through the use of asbestos fiber at temperatures much above 1,100 or 1,200 deg. Unforturately, the incorporation of other types of bonding materials, such as clays, resistant to high temperatures, detracts from the natural insulating characteristics of the other ingredients. It is necessary, therefore, to balance mechanical strength requirements and insulating effectiveness.



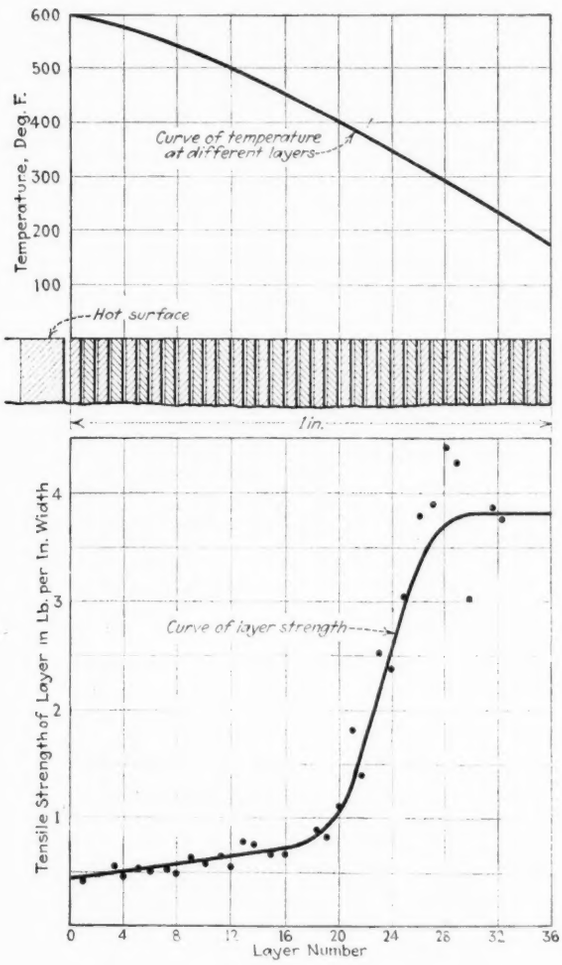
Hair felt insulation arranged to keep out moisture

Carbonate of magnesia is a manufactured product obtained from dolomite rock, which is a mixture of carbonate of magnesia and carbonate of lime. By a series of chemical processes the lime is separated from the magnesia. Manufactured carbonate, mixed with asbestos and water and molded into shapes, is commercial 85 per cent magnesia.

Carbonate of magnesia is a white crystalline structure, possessing high cohesive properties up to a temperature of 500 deg. At this temperature the carbonate starts to give off its water of combination and carbon dioxide gas. This process is called calcination, and results in the change of the carbonate into the oxide of magnesia. Although the insulating characteristics of the calcined material are as good as those of the carbonate, the natural cohesiveness between the crystals is greatly reduced

This chemical change limits the permanent and satisfactory working temperature of 85 percent magnesia to between 550 and 600 deg.

Diatomite is sometimes called Kieselguhr, diatomaceous earth or infusorial earth. It consists of microscopic skeletons of small sea animals, beds of which occur in many parts of the country, but chiefly on the Pacific Coast. Some of these earths are heavy and dense and are poor insulators, but California earths are light and possess good insulating qualities.



Effect of temperature on layer strength in laminated insulation

Clays are used in some types of insulating products as fillers and as adhesive bonding materials. Their use should be limited, because clays seriously reduce the insulating efficiency of a material. Clays are quickly softened and reduced to a plastic condition by water, the fluidity of the clay depending upon the amount of water present. Insulating materials containing clays should be avoided, because of the uncertainty of permanent satisfaction if the insulation is likely to be exposed to moisture either from the elements or from leaks in the piping.

Clays are used extensively in the manufacture of insulating cements, and for this purpose should be white, bulky and finely divided. They should have good bonding and adhesive properties and their drying shrinkage and heat shrinkage should be low.

Silicate of soda is a product manufactured from soda ash and sand and commonly called water glass. This is a heat-proof material and will stand 1,300 deg. or 1,400 deg. before it decomposes. Hence it is used in the manufacture of asbestos insulating materials as an adhesive.

Asbestos paper insulations, although composed principally of asbestos fiber, contain a percentage of insoluble organic binder. The binder, usually flour or paste, is necessary in the manufacture of asbestos paper, because the asbestos fibers, which are relatively smooth, will not felt or mat without it. The binder, being organic, burns out and decomposes at temperatures around 300 deg. F., resulting in a weakening in the asbestos paper structure, although the asbestos fiber itself is not affected by the heat. The limiting temperature at which asbestos paper insulations should be used is largely a matter of opinion.

As the binder decomposes and burns out of the asbestos felt the mechanical strength of the felt is reduced. The extent to which decomposition will go, that is, the number of plies which will suffer a reduction in strength, depends upon the temperature of the surface covered. Some engineers are not impressed with a loss in strength of the asbestos felt, while others place certain limitations upon the maximum temperatures at which asbestos felt covering should be used. One manufacturer, to insure reliability of service to users of multi-ply insulation, recommends 450 to 500 deg. F. as the maximum temperature at which its product should be employed. These limiting temperatures are recommended even though the asbestos felt contains but a very small percentage of binder, not exceeding 3 per cent. Such a recommendation, which recognizes practical limitations of the material, assures the user of permanent and satisfactory performance.

(The next article by E. F. Zeiner will discuss tests for comparing the physical properties of insulation. —Editor.)

New Type Tow-Boat Has Diesel Electric Drive

A NEW TYPE of diesel electric river tow-boat recently made its appearance at Pittsburgh, Pa., with a tow of cement laden barges for delivery up the shallow Muskegon River in the Marietta, Ohio, district.

The craft is powered by two diesel-engine-generator sets, which supply energy to two 80-hp. motors. The motors, instead of being connected to the usual stern-wheel, drive two sets of paddles on each side by means of which the boat "crawls" through the water. These paddles running on endless chains like buckets on a sand or coal conveyor enable the craft to proceed at an average speed of four miles an hour with a tow about twice as large as a boat of her size is expected to handle.

Because of the paddle arrangement combined with extreme ease and reliability of control, no rudder is necessary. The pilot sits comfortably in an armchair between two levers with a full view of the river and pushes or pulls the left or right lever, controlling the left or right train of paddles, according to his desire to go left or right. The boat can turn around in its own length—just like a man in a row-boat who pulls on one oar and backs water on the other. The driving mechanism is particularly free from shock and vibration.

The paddle arrangement enables efficiency to be maintained even in a three-foot draught; whereas, tow-boats with stern or side-wheels lose a great deal of their efficiency in shallow water.

2,500-HP. Motor Capacity on AUXILIARY DRIVES

By VICTOR LIPTON
Opuls & Hill, Inc., Consulting Engineers, New York City

In the new power plant of Anheuser Busch, Inc., 2,300-volt motors are used on the pulverized-coal equipment and sluicing pumps and on the other drives 220-volt motors are used. The control on the combustion equipment motors is interlocked to prevent operating mistakes by the attendants

▼

POWER PLANTS are generally not considered places where large installations of motors and controllers are made. In the older type of stations the capacity of motors installed was usually comparatively small, but in modern high-pressure installations burning pulverized coal the total horsepower of motors may be surprisingly large. A good example of such an installation in a large industrial power plant is that of the Anheuser-Busch, Inc., St. Louis, Mo. The main units in this plant, as described in the June 17 number of *Power*, consists of two 3,750-kva., 2,300-volt turbine-generators, with space for a third unit, and three 10,760-sq.ft., 500-lb. boilers, with space provided for a fourth.

As shown in Table I, when full capacity is installed the boiler room and pulverized-coal plant will have 3,700 hp. of motors. At present 2,500 hp. is installed. These motors range in size from ½-hp. units on the automatic scales, up to 300-hp. machines on the induced-draft fans. The motors on the coal pulverizers, draft fans, boiler feed pumps and sluicing pumps are operated on 2,300 volts, and the other motors are supplied with 220-volt power. The latter are 30-hp. and less in capacity. The 2,300-volt motors all are 100-hp. or larger in capacity, with the exception of those on the pulverized-coal mill fans, which are only 25 hp. capacity each. The boiler feed pumps are at present driven by steam turbines, but their shafts are extended so that motors may be installed at any time.

On account of the high starting torque required for the pulverized-coal mills, wound-rotor induction motors were selected. These motors, as shown in Table II, are

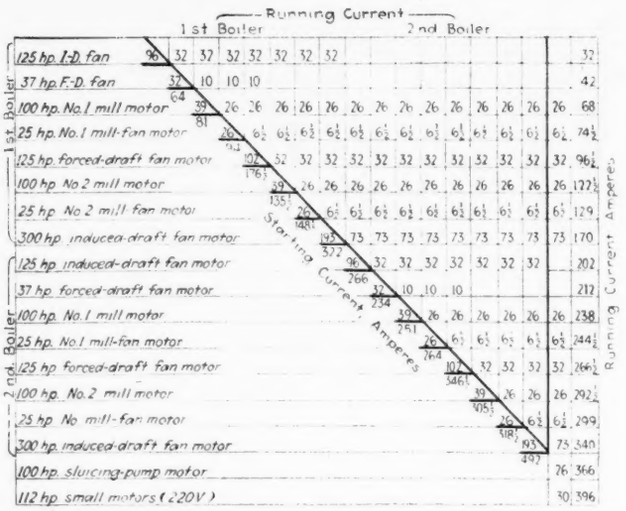

Running Current
1st Boiler
2nd Boiler
125 hp. I-D. fan
37 hp. F-D. fan
100 hp. No. 1 mill motor
25 hp. No. 1 mill-fan motor
125 hp. forced-draft fan motor
100 hp. No. 2 mill motor
25 hp. No. 2 mill fan motor
300 hp. induced-draft fan motor
125 hp. induced-draft fan motor
37 hp. forced-draft fan motor
100 hp. No. 1 mill motor
25 hp. No. 1 mill-fan motor
125 hp. forced-draft fan motor
100 hp. No. 2 mill motor
25 hp. No. mill-fan motor
300 hp. induced-draft fan motor
100 hp. sluicing-pump motor
112 hp. small motors (220V)
Starting Current, Amperes
Running Current, Amperes

Fig. 1—Starting and running currents required by motors

TABLE I—LIST OF MOTORS DRIVING AUXILIARY EQUIPMENT

Volts	Number	Motors	Number Pres.	Number Fut.	Hp. Each	Connected Load, Hp Pres.	Connected Load, Hp Fut.	Connected Load, Hp Total
2,300	1– 8	Pulverizer mills	6	2	100	600	200	800
	9–16	Mill fans	6	2	25	150	50	200
	17–20	Induced-draft fan	3	1	300	900	300	1,200
	21–24	Forced-draft fans	3	1	125	375	125	500
	25–27	Boiler feed pumps	.	3	200	....	600	600
	88–29	Sluicing pumps	2	..	100	200	.....	200
	31	Sluicing pump	1	..	15	15	.....	15
220	32–33	Sump pumps	2	..	30	60	.....	60
	34	Coral crusher	1	..	10	10	.....	10
	35	Coal conveyor	1	..	10	10	.....	10
	36	Cross conveyor	1	..	5	5	.....	5
	37	Chemical pump	1	..	7½	7½	.....	7½
	38	Elevator	1	..	10	10	.....	10
	39	Battery charging	1	..	12½	12½	.....	12½
	40	New coal convey. system	..	1	25	....	25	25
	41	Ash hoist	1	..	5	5	.....	5
	42–49	Scales	6	2	½	3	1	4
	50–53	Mill fan draft control	3	1	½	1½	½	2
	58–59	Turbine aux. oil pump	2	..	1	2	.....	2
	60–67	Coal feeders	6	2	2	12	4	16
	68	Oil filter	1	..	2	2	.....	2
	69–70	Booster pumps	2	..	10	20	.....	20

TABLE II—AUXILIARY MOTORS PER BOILER

Equipment	Number	Type	Speed, R.p.m.	Size, Hp.	Volts
Pulverizers	2	Wound-rotor	450	100	2,300
Mill fans	2	Squirrel-cage	1,200	25	2,300
Induced-draft fan	1	Squirrel-cage	1,150	300	2,300
		Pole-changing	860	125	
Forced-draft fan	1	Squirrel-cage	1,750	125	2,300
		Pole-changing	1,150	37.5	
Mill feeders	2	Squirrel-cage	1,150	2	220

Normal load, 325 kw.
Maximum continuous load, 525 kw.
Maximum instantaneous load, 650 kw.

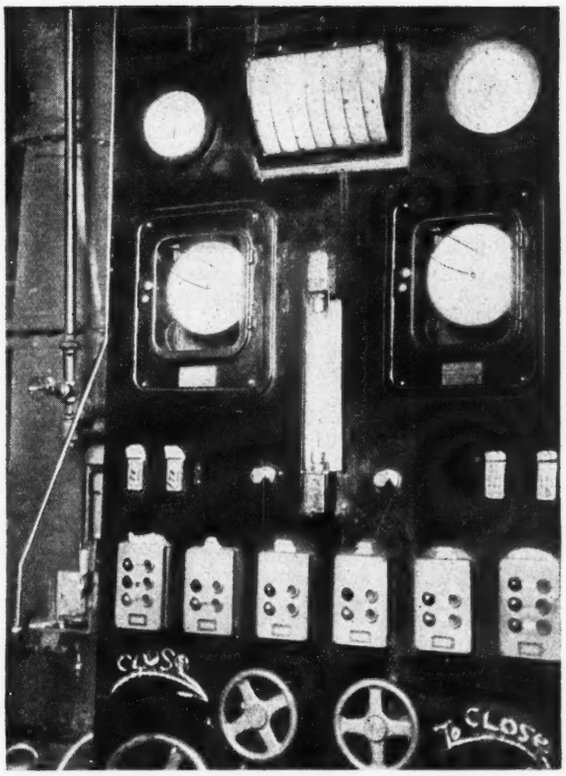


Fig. 2—Boiler panel on which all the control is concentrated. Push buttons shown near the bottom of the panel are for the control of the motors on the draft fans, pulverizing mills, feeders and scales

of comparatively slow-speed design and operate at constant speed. The induced- and forced-draft fans are driven by two-speed squirrel-cage motors. On the induced-draft fans the speed change is from 1,150 to 860 r.p.m., or 25 per cent. A 33 per cent speed change is provided on the forced-draft fans, or from 1,750 to 1,150 r.p.m. This is sufficient to take care of a steaming range on each boiler of 30,000 to 150,000 lb. The motors on all the other drives are of the single-speed, squirrel-cage type.

On the 2,300-volt motors the controllers are equipped with direct-current magnets, and control of the motors is by push buttons on the panel board at each boiler, Fig. 2. From these panels the motors can be started, their speed changed and stopped by pushing a button. Thus the control of each boiler has been arranged at a central location. The sequence of control of the boiler motors is as follows:

The induced-draft fan is started on slow speed; then the forced-draft fan is started on slow speed. When the induced- and forced-draft fans are running on slow speed, the mill is brought up to speed, after which the feeder is started. When more capacity is required than can be supplied by the induced- and forced-draft fans operating at slow speed, the forced-draft fan motor is switched to high-speed operation. Then the second mill-fan and mill-feed motors are started and No. 2 mill is put in operation. Maximum boiler output is obtained by switching the induced-draft fan's motor to high speed.

Fig. 1 was worked out to show the peak load that the plant might be subjected to during the starting of a boiler. For No. 1 boiler the 125-hp. motor on the induced-draft fan is started first. This motor takes a peak current of 96 amp. at starting, which value is shown to the left of the diagonal line. After the motor reaches normal speed the current drops to 32 amp. as shown to the right of the diagonal line. Next the forced-draft fan motor is started, and takes a peak current of 32 amp. This current added to the running current of the induced-draft fan's motor gives a total peak of 32 + 32 = 64 amp. To start the 100-hp. No. 1 mill motor requires 39 amp. and puts a peak of 32 + 10 + 39 = 81 amp. on the system, as shown to the left of the diagonal line. This process is continued all the way down the diagram until the two boilers are on the system and operating at maximum capacity. At the bottom of the diagram is added the running current of the 100-hp. sluicing pump and the 2,300-volt running current for the 112 hp. of 220-volt motors, which make a total running current of 396 amperes.

Starting and running currents are plotted to form the curve in Fig. 3. When the 125-hp. induced-draft fan motor on the first boiler is started the current jumps to 96 amp., and as the motor reaches normal speed the current drops to 32 amp. Starting the 37-hp., forced-draft fan motor causes an increase in the current to 64 amp., which drops to 42 amp. at normal speed. The motor on No. 1 mill takes an inrush current of 39 amp. and raises the peak to 81, but this drops to 68 amp. as the motor reaches normal speed. This process is followed until the boiler is operating at maximum rating, when the full-load running current is 170 amp., but the peak was 322 when the induced-draft fan motor was connected to the line to give high speed. If the sluice pump and the 112-hp. of small motors are running, the total running current is 226 amp. The position of the curve for the second boiler is obtained on the assumption of 170-amp. load for the first boiler. The curve for the second boiler is obtained in the same manner as for the first.

The boilers are regulated by automatic combustion control, and all the operations of the equipment are

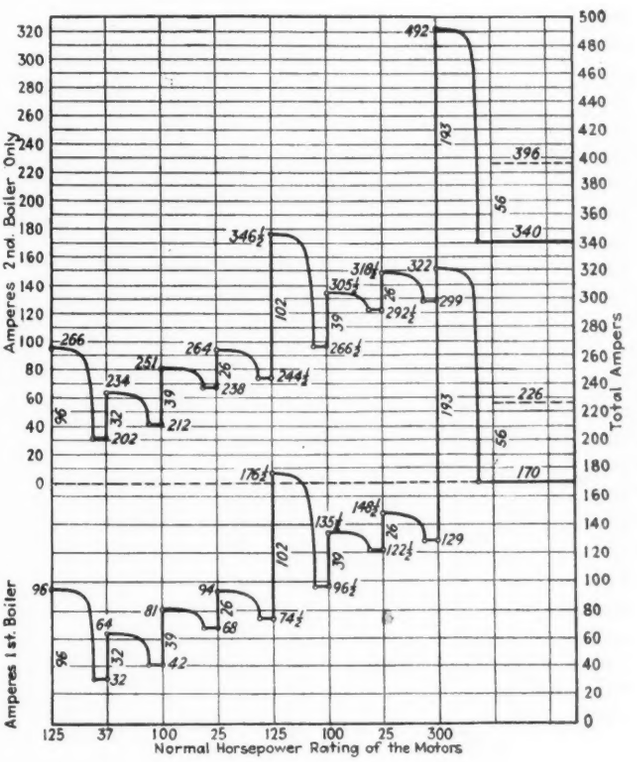


Fig. 3—Curves show starting and running currents required by motors

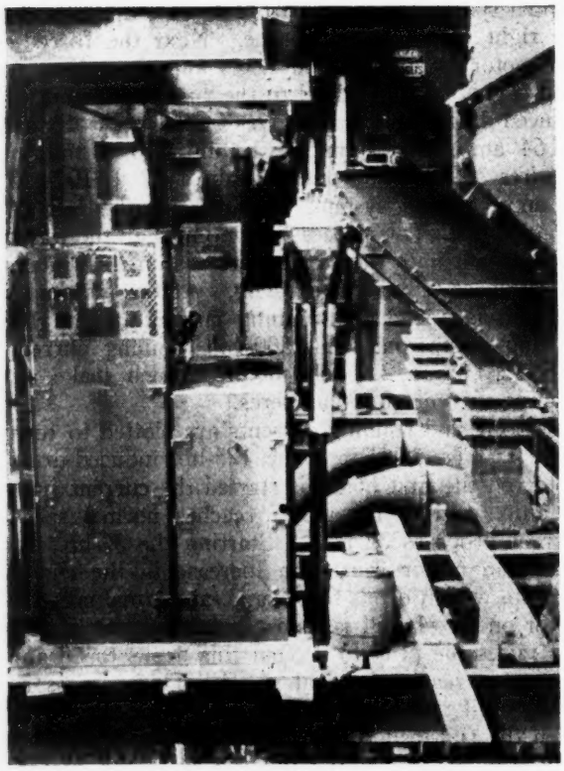


Fig. 4—Pulverizing-mill-motor controllers are located on a platform above the mills

interlocked to prevent an attendant's making a false operation. The interlocking system also automatically prevents incorrect operation of the equipment after it is put into service. In case of a shutdown of the induced-draft fan on one of the boilers, all the other fans, mills, and mill-feed motors on this boiler will be tripped off the system. If a forced-draft motor is shut down the mill-fan, mill and mill-feeder motors are shut down. Shutting down a mill fan causes the mill and mill-feeder motors to be tripped off the line. The mill-feeder motor stops if the mill is stopped for any cause.

The forced-draft fan is locked out and cannot be started until the induced-draft fan is running at low speed. The two mill fans, the two mills and the two mill-feeder motors are locked out until both the induced- and forced-draft fans are running at slow speed. Changing the induced-draft fan motor from low to high speed, or from high speed to low speed does not shut down the forced-draft fan motor. Also, the forced-draft fan motor can be changed from one speed to the other without causing the mill equipment to shut down.

Each controller on the boiler combustion equipment has an instantaneous relay to trip the main circuit breaker at the switchboard. In the event of a short circuit in any one of these motors, opening of the controller on the faulty motor is delayed long enough for main circuit breaker at the switchboard to open.

Time limits are provided in the control equipment so that when changing either the induced- or forced-draft fan motors from high to low speed, the motors will drop to the lower speed before connecting them to the line again. This is to prevent a sudden retardation and possible damage to the fan.

Locking short-circuiting switches are installed in the control circuits of the mill-fan and mill motors to allow the mill and mill feed to be run cleared of coal at times, when the induced- and forced-draft fans are not operating.

High Pressure Power Plant In German Coal Mines

LARGE AREAS in Germany depend on brown coal as their main fuel, and in view of the characteristics of this material, special methods have to be adopted for its treatment. Normally it occupies great bulk, contains much water and is very friable, as compared with bituminous coal. For transportation it is therefore frequently briquetted, in which process large quantities of heating steam are required.

In the East Elbe district the brown coal contains about 57 per cent of water, and about 1.5 lb. of steam are required to dry 1 lb. of coal, using pressures ranging from 2 to 4 atmospheres. It is common practice, in this industry to use back-pressure generating sets, employing the exhaust for the drying service, and the initial pressure selected obviously should depend upon the relation between power requirements and steam demand in any particular plant.

Due to a growing electrical load, the Ilse Bergbau Aktien Gesellschaft decided, not long ago, to erect a new back-pressure plant of the kind outlined, and calculations showed that 1,700 lb. per sq.in. gage pressure yielded maximum economy. About 87 and 97 tons of steam per hour represent the normal and maximum requirements of the Renate briquette works, at which the new plant is located. In order to use such a high pressure, reheating was essential and this necessitated a further steam supply of about eight tons per hour at full load. Four boilers were planned, but only two as yet are erected; their individual capacity is 68,000 lb. of steam per hour at normal rating, at 1,700 lb. per sq.in. Superheaters are provided to give 890 deg. F., with a pressure drop of 43 lb. per sq.in. At the turbines the steam is roughly at 1,500 lb. and 840 deg. F. Feed water is mostly derived from condensate, returning at 35 lb. per sq.in. and 265 deg. F. It is then passed through an economizer which, together with an air preheater, reduces the slack temperature to approximately 480 deg. F. at normal load; a lower temperature would not be justified owing to the low cost of fuel.

One of the boilers has a heating surface of 5,520 sq.ft., and has solid forged top drum with a 4-in. shell, while the bottom drum is 3.2 in. thick. The superheaters are beneath the bottom drum and have a total heating surface of 2,570 sq.ft. Wrought-iron tubes of 7,350 sq.ft. surface are used in the economizer, while the air preheater has 7,750 sq.ft. surface.

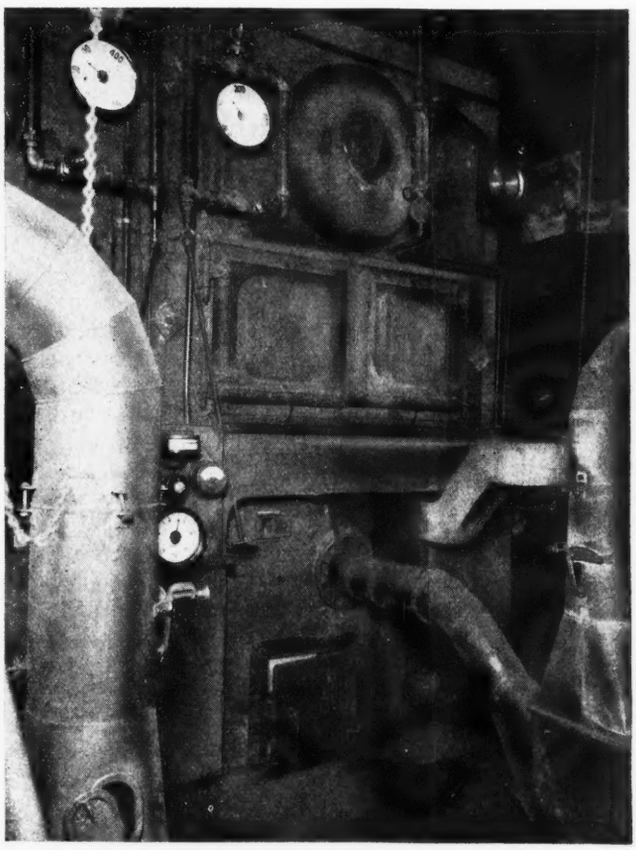
The second boiler has 5,000 sq.ft. heating surface, with 4-in. thick upper and lower forged steel drums. Ten downcomers located in the side brickwork insure adequate circulation. Superheaters of 6,450-sq.ft. area and economizers of 9,130 sq.ft. are followed by an air preheater of 8,600 sq.ft. To both boilers desuperheaters are added, injecting feed water into the steam so as to give a close control of the final steam temperature.

The two turbines are triple-casing machines, with a capacity of 12,000 kw. at 3,000 r.p.m. At the end of the second casing all the steam is extracted at about 192 lb. per sq.in. and 428 deg. F. to be reheated. Normally, about 40 tons of the 80 tons of reheated steam is supplied to the briquette presses and feed pumps, and the remainder is expanded down to 36 lb. in the low-pressure turbine, thence passing to drying drums.

—*The Power Engineer.*

MODERNIZING A 25-Year-Old Plant

By J. EDMUND ZIEGLER
Superintendent, George Ziegler Co.



Close-up of boiler front, showing burner and instruments

Installation of unit pulverizers and air-cooled furnace walls and generation of byproduct power gives improved service at relatively low cost

FOR 69 years the George Ziegler Company, Milwaukee, Wis., has been making candy. Up until the summer of 1928 much of the electric power had been purchased at a rate of 2½c. per kilowatt-hour, while steam was generated for heating the buildings, cooking, drying, and other processes involved in the making of candy. After careful analysis it was decided to make the necessary changes in the boiler room and plant to permit of combining the two services, thus eliminating purchased service except for stand-by and night use. Generating units had been installed previously, but lack of boiler capacity had limited the output.

On June 6, 1928, under the supervision of H. S. Price, chief engineer, workmen started to tear out all old brickwork and boiler settings, clean up the boiler room, and rearrange things for the new installation. The Ziegler men removed all brickwork, did the necessary excavating, built the new boiler breechings, installed two unit pulverizers, covered all piping with 85 per cent magnesia, and did the necessary wiring for the pulverizer and blower motors.

Meanwhile new air-cooled boiler settings were being built. On July 9 the alterations had been made and the plant was placed in service. It has operated every day since without a single emergency shutdown. Following is a summary of the entire cost:

Tearing down old walls, excavating, erecting, breeching, installing pulverizers, connecting up motors, covering pipes, etc.	$3,196.85
Boiler settings, air-cooled walls complete	3,040.68
Unit pulverizers, delivered to job	5,500.00
	$11,737.53

The boiler room contains the two original Parker boilers, each having 1,960 sq.ft. of surface and delivering steam at 150 lb. pressure. Installed in 1907, these boilers have been in service for 23 years. They are now equipped with an insulated steel breeching and a concrete stack 160 ft. in height, with a bottom inside area of 58x58 inches.

Each boiler is served by a Strong-Scott pulverizer driven by a 15-hp. induction motor. The load on these motors averages from 7 to 10 hp. Each is equipped with an ammeter, so that by the current taken the fireman may judge the rate of coal feed and air supply. The furnace floor is 7 ft. 6 in. from the lower row of tubes, and the walls are spaced 6 ft. 8 in. at the center of the furnace, with a taper of 4 in. to the top, while the length is 19 ft., giving a total volume of 982 cu.ft. of furnace combustion space. For much of the time both boilers are kept in service.

The drawings show sections of the boiler setting and the Plibrico monolithic air-cooled wall, with a detail of

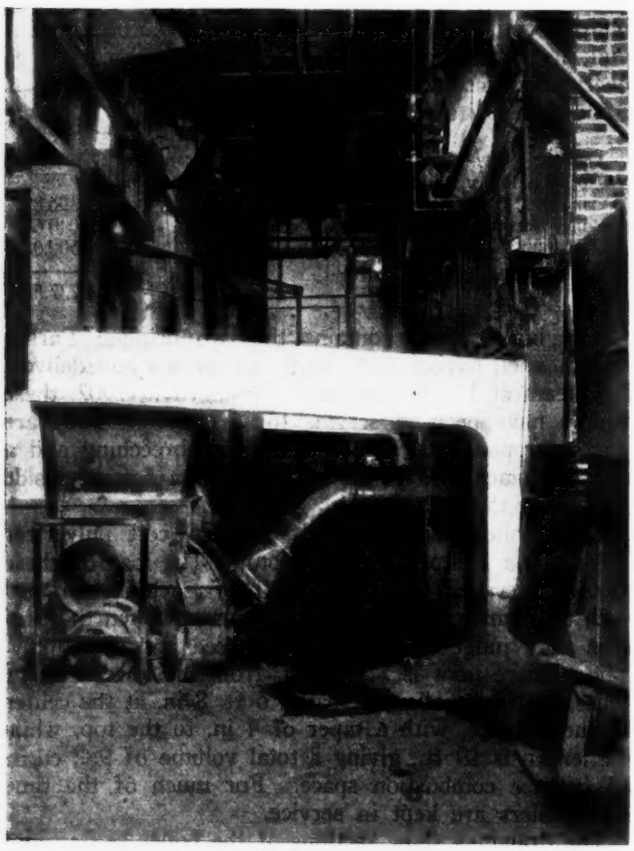
the flexible anchors for holding the plastic refractory to the outer furnace wall. Incidentally, plastic firebrick also lines the doors. The service is severe on refractories. A cold boiler is brought up to steaming pressure in 40 min. and a hot boiler in 10 min. Each boiler is operated six weeks at a time without shutdown, the load ranging from 4,200 to 16,000 lb. of steam per hour. At the end of that period a boiler is shut down for washing and removing the fly ash from the tubes and the floor. During the two years' operation not a single repair has been made to either the wall or the door linings.

Air preheated in side-wall ducts is collected at the furnace front and carried through an overhead duct to the pulverizer, a distance of eight feet. This preheated air dries the coal and provides the necessary primary supply for combustion. The duct is equipped with a damper so that air taken into the pulverizer may be regulated according to the load and the CO_2 indications. A thermometer in the duct makes it possible to watch the air temperature, which, with damper wide open, will range from 230 to 500 deg. F.

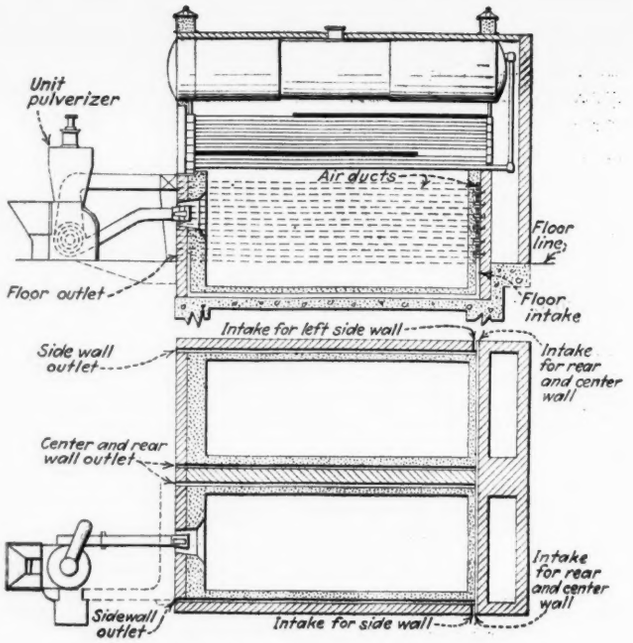
Each boiler is equipped with a CO_2 indicator and a draft gage. A pyrometer is installed in the breeching, and a steam flow meter indicates the output. The fireman watches the CO_2, the steam-flow meter, the ammeter in the pulverizer motor circuit, and the thermometer in the auxiliary air duct. With this information he is able to maintain the steam pressure under varying loads, keeping the carbon dioxide between 12 and 14½ per cent.

Feed-water regulators control the supply of boiler water, which is raised to a temperature of 218 deg. in a combination open and closed heater. All feed water is metered by a 2-in. turbine meter.

The coal used is from West Kentucky, costing approximately $3.50 per ton delivered. Each boiler has its own concrete bin so that its consumption of fuel can be more readily recorded. The coal comes in by rail, and the railroad's weights are accepted as correct. In addition to the chief engineer, who has charge of the mechanical equipment throughout the entire plant, one assistant engineer and one fireman operate the plant.



Unit mill installation, with overhead hot-air duct in foreground



Plan and elevation through boiler installation

Owing to the fact that the building is of solid and tight construction, the plant may be closed down from 6:30 p.m. until 6 a.m., next day without the building becoming uncomfortably cold, even during severe winter weather. Because of the thick, air-tight furnace walls, radiation, leakage, and conduction losses are low. If a boiler is shut down at 6:30 p.m. with the pressure at 150 lb., the pressure will be 70 lb. at 6 a.m. In the morning the blower is started up, pulling air direct from the furnace and recirculating it. Ignition is secured by the usual method of placing a burning oily rag in front of the burner and turning on the coal. Pressure of 150 lb. is attained in 10 min. It was feared that such quick steaming would injure the furnace walls, but after two years of this sort of service, plus a load that fluctuates from 70 to 275 per cent of rating and may stay around 150 per cent for an hour at a time, there is no sign of cracks or spawling.

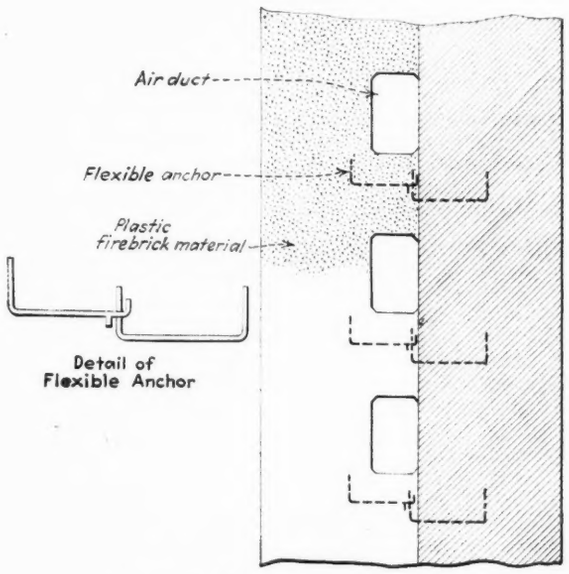
In the engine room there are two noncondensing engine-driven generating units operating against 5 lb. back pressure. The generators are 240-volt, three-phase, 60-cycle machines rated at 300 and 125 kw., respectively. The former is driven by a 500-hp. uniflow engine, and the smaller generator by a non-releasing four-valve engine. When necessary the units may be operated in parallel, but the larger machine will carry the load most of the time.

For refrigeration there are two compressors of 35 and 100 tons capacity. The smaller machine is driven by a reciprocating engine, and the larger by a synchronous motor with belted exciter. During the winter the engine-driven unit is operated, because the exhaust steam can be used. In the summer, when additional refrigeration is required, use of the motor-driven unit helps to improve the power factor.

Scattered throughout the plant are some 218 motors.

all but one being of the squirrel-cage or wound-rotor types. The largest motor is of 190 hp. capacity, but there are many small motors rated at $\frac{1}{16}$ hp. The total connected motor load is about 1,230. The predominance of squirrel-cage motors makes for low power factor, but by driving the refrigerating machine with a synchronous motor it is possible to bring the power factor up to between 78 and 85 per cent, according to the load.

At the time the change was made it was desired to interchange power with the utility, but as an agreement could not be reached the candy plant never draws upon the central station supply except during the night, when its own plant is shut down. Purchased service is limited



Section of air-cooled monolithic wall

to night lighting and fire pump supply, the load averaging about 85 kilowatts. When this load increases to 100 kw., it has been estimated that the company can afford to carry it by operating the small generator.

Records of coal consumption date back to 1924, of kilowatt-hour produced to 1927, when the meter was installed, and of steam used, to 1928. These data are given in Table I.

Notwithstanding increasing production in the factory the trend in coal consumption has been downward, when a growing electrical load is considered. In 1929, a long, cold winter and a marked increase in kilowatt-hours generated, as well as an increase in the steam for high-pressure cooking, resulted in an increase in coal consumption of somewhat less than 400 tons of coal over 1928. It is interesting to notice that the coal consumption was 182 tons less in 1929 than in 1924, notwithstanding that 647,300 kw.-hr. was generated in 1929, while in 1924 an average load of only 125 kw. was carried by an engine unit to furnish exhaust steam.

TABLE I—OPERATING DATA OF PERIOD OF YEARS

Year	Total kw.-hr. Generated	Total Coal Consumed, Tons	Total Steam Generated, lb.	H.P. Steam for Cooking, lb.
1924	.....	2548	.....	.....
1925	.....	2280	.....	.....
1926	.....	2048	.....	.....
1927	298,200	1676	.....	.....
1928	425,600	1912	33,947,367	9,052,816
1929	647,300	2366	42,043,124	9,296,800
1930 To May 1	182,800	723	13,679,969	3,319,200

Although not complete, Table II will give some idea of operation in 1929. Some of the pertinent items are the steam consumption figures for the various services, an average evaporation of 8.88 lb. of water per pound of coal, a pulverizer power requirement of 16.3 kw.-hr. per ton of coal, and a pulverizer maintenance charge of 3c. per ton. In a remodeled plant of this character overhead is a confusing item, and has been omitted. Labor consists of a salary of $3,600 for the chief engineer, who oversees and has charge of all mechanical equipment in the manufacturing plant as well, so that at least one-half of his salary should be charged to the factory. This also holds true of the assistant engineer who is paid $2,300 per year. One fireman is employed. He receives $2,028 per year. Previous to the installation of the unit mills two firemen were retained.

TABLE II—PLANT PERFORMANCE DURING 1929

Total steam generated, lb.	42,043,124
Coal, lb.	4,733,800
Average evap. per lb. coal, lb.	8.88
Fuel cost per 1,000 lb. of steam, c.	21.2
Kilowatt-hours generated	647,300
Steam to uniflow engine, 34.8 lb. per kw.-hr., lb.	22,526,040
Live steam for cooking and heating, lb.	9,296,800
Steam for refrigeration, lb.	8,538,560
Steam for auxiliaries, 4 per cent of total, lb.	1,681,724
Labor chargeable to plant	$4,971
Maintenance, total	$1,354.12
Pulverizer maintenance, 13 sets of hammers at $5.40	$70.20
Pulverizer maintenance per ton of coal, c.	3
Power for pulverizers, kw.-hr.	38,754
Pulverizer power per ton of coal, kw.-hr.	16.3

From the foregoing it is evident that the plant is giving much better service than it had in the past, and at a considerably lower cost. The remodeled plant affords a valuable example of what can be done with existing equipment where there is the will to do it and where the facts permit of intelligent change and operation. That boilers that have been in service some 23 years can be reset and equipped with the most modern method of burning coal, and "stay put" under severe load conditions without any sign of difficulty, suggests that many similar opportunities may exist throughout industry. The entire absence of emergency shutdowns for over two years also demonstrates that when properly designed and operated the industrial plant may provide all that is required in the way of dependability.

New Heat Transfer Test

A NEW METHOD of test for comparing the thermal conductivities of solid electrical insulating materials has been issued by the American Society for Testing Materials, which is designed to provide a simple and convenient means for determining the thermal conductivity of electrical insulating materials, and is intended for use in testing laboratories which are not specially equipped for heat transfer work. The method is the thermal analogy of the potentiometer method of comparing electrical resistances. A specimen of unknown conductivity is placed in series with a standard specimen of known conductivity between plates which are maintained at different temperatures. The respective temperature differences across the standard and the test specimens when a steady state of heat flow is attained are inversely proportional to their relative conductivities. The conductivity of the standard specimens must, of course, be measured by an absolute method.

This tentative A.S.T.M. method is designed for an accuracy of ± 5 per cent which is sufficient for all present practical purposes.

ORIFICES for Building Heating Control

By L. K. FERRIS
Detroit, Mich.

In a large office building equipped with orifices use of a moderate pressure differential and manual control of the steam to zoned sections of the heating system resulted in a 10 per cent reduction in steam

NOT MANY years ago the main objective in the design of heating systems for all types of buildings was simply to provide sufficient heat for comfort in the most severe weather. Regulation of building temperature was largely left to the occupants, who were obliged to turn radiators on or off according to their own requirements.

Today provision is made at least for the regulation of the heating system in accordance with weather conditions, and in many cases for the control of humidity and for cooling of the air during the summer months. This article is concerned only with temperature control, principally by the use of orifices.

Regulation of temperatures in buildings may be accomplished in a number of different ways. Thermostatically controlled valves operated by electricity or compressed air give almost ideal results, but are expensive. Special self-contained thermostatic radiator valves have been and are being developed and probably will come into more general use. These valves require no separate thermostats or other special connections. The thermostatic element is contained in the valve itself. These units also are relatively expensive.

Some degree of temperature control may be obtained by dividing heating systems into small zones, each of which may be turned on or off by remote control from a central control board. With such an arrangement some means should be provided for informing the operator of the temperatures prevailing in the various zones, such as a series of electric resistance thermometers with the instruments installed at a central point for the convenience of the operator.

Orifices in radiator inlet connections for control of the heat supply have become common. The practice is to be commended specially for improving the operation of older installations where no special means have been provided for regulation of the steam supply according to weather conditions.

In principle, the orifice is a device through which a definite quantity of steam will flow, depending upon the pressures existing at the supply and discharge sides of the orifice. The quantity of steam flowing through the orifice may be controlled by regulating either one or both of these pressures. The flow of steam also varies inversely as the square root of the quality, but as the moisture content is small in heating work this factor may be neglected in calculating orifice diameter.

In the application of orifices to a heating system, calculations are made on the basis of certain pressure conditions or certain ranges of pressure, governed by the conditions of the particular installation. A satisfactory arrangement is one in which the vacuum, or return, pressure is maintained constant for all operating conditions and the supply pressure is regulated to suit the heating requirements more or less according to weather conditions. The orifices are calculated so that at a predetermined differential between the supply pressure and return pressure, or vacuum, sufficient steam will be passed to keep the radiator filled with steam under the most severe heating conditions. It is assumed that the radiation has been calculated so that each radiator is of such size that it will work at the same per cent of its rating as all other radiators in the building. The pressure existing in the radiator will be the same as that maintained in the return line, since the trap remains open as long as the radiator is not completely filled with steam.

Range of Pressure Differential Across Orifice

For maximum steam requirement the pressure differential may be anywhere from 1 to 3 lb. per square inch. As the maximum pressure differential is increased the diameter of the orifice opening is decreased. With the higher differentials there is an increasing tendency for the orifice to whistle or to be noisy. On the other hand, regulation may be more accurate with the wider ranges of differential, since slight variations in pressure will have less effect on the flow of steam. In installations where the radiation has been calculated on on a liberal basis, orifices having a pressure range of

3 lb. per square inch may be used without objectionable noise, for usually there will be only short periods when the system need be operated at differentials exceeding two pounds.

A satisfactory operating range lies between a vacuum on the return line of 3 in. of mercury and a supply pressure of 1½ lb. per square inch gage for 100 per cent flow. Operating in this range there is less probability of disturbances in the return piping from the influx of air. With a reasonably tight system and with lines properly pitched to drain, the variation of pressure throughout the return system will be negligible.

Orifices are inserted in the supply connections to the radiators preferably with the disk in a vertical plane between the supply valve and the radiator and not lower down than the entrance pipe into the radiator. The disk may be a part of the radiator bushing or valve tailpiece or may be a separate piece inserted between these parts. It may be of any thickness up to ⅛ in. All the disks should be of uniform thickness, and the orifices drilled through carefully to avoid burrs. It is not recommended that the holes be chamfered or bell-mouthed, since such work may not be uniform. A sharp-edged hole will give good results. Flow of steam through the orifice is not at such high velocity that difficulty is experienced with cutting or wire-drawing.

Calculating the Steam Flow

Flow of steam through an orifice varies directly in proportion with the area of the opening. When the discharge pressure is less than 58 per cent of the supply pressure, measured in absolute units, the flow through the orifice varies almost directly as the supply pressure in absolute units, as expressed by Grashof's formula.

$$F = \frac{A_0 \, P_1^{0.97}}{60}$$

Where,

F = Flow of dry steam in pounds per second.
A_0 = Area of orifice in square inches.
P_1 = Supply pressure in pounds per square inch, abs.

However, in heating work the discharge pressure P_2 always is more than 58 per cent of the supply pressure Under these conditions certain coefficients must be used and Grashof's formula then becomes,

$$F = K \times \frac{A_0 \, P_1^{0.97}}{60}$$

From experimental studies Rateau prepared the curve, Fig. 1, from which these coefficients can be determined, depending upon the ratio of the absolute discharge pressure to the initial pressure.

In calculating orifice sizes it is necessary only to determine from the foregoing formula the steam flow in pounds per second for an orifice having an area of 1 sq.in. for the particular pressure conditions under which the orifice is to be operated at 100 per cent flow. Calculating the rate of flow required for a given radiator at 100 per cent performance, the area of the orifice for the given radiator will be directly proportional to the ratio of desired flow for the radiator to the flow from an orifice of 1 sq.in. area under the same pressure conditions.

Selection of the size of orifices for various radiators will be based on the rate at which the heat should be supplied under average conditions in the particular locations. An important factor to consider is the rate of heating required during the warming-up period each day following the night-time shutdown. It will be found that lower floors of a building will be at a much lower temperature before the warming-up period and will not reach the proper level of temperature as quickly as the upper floors.

Some consideration also should be given to the probable drop in pressure in the supply mains before the more remote radiators are reached. Usually, in a system where pipe sizes have been selected properly, this item is of minor importance, particularly where the operating differential is confined to the narrow limits of 2 or 3 lb. As a matter of fact, during the greater part of the heating season the system probably will be operating under conditions calling for not over 50 per cent of maximum steam flow. With such requirements the pressure drop in the steam supply mains to the most remote points should be only a small amount. Further, the particular advantages from the use of orifices are to be gained during weather conditions when only a small percentage of the maximum flow is required if overheating is to be avoided. Under such conditions variations in pressure differential are important, but with small flow requirements, line pressure drops become negligible.

Orifices are used so that only that percentage of flow to the radiators is permitted as may be required for the particular weather conditions. If a heating system is designed to give an inside temperature of 70 deg. F. with an outside temperature of zero, with some allowance for heating up and for wind conditions, the radiators need only about one-half of their maximum condensing capacity when the outside temperature is at 35 deg. If thermostatic control is not provided there will be overheating unless the occupants of the building turn the radiator valves on or off according to their own requirements. Usually the occupants open windows rather than turn off the radiators, and, as a consequence, a great amount of steam is wasted. If such a system has orifices installed before the radiators, it is possible for the operating engineer to so regulate the differential pressure between the supply and return mains that approximately only sufficient steam will be admitted to the radiators to maintain proper room temperatures.

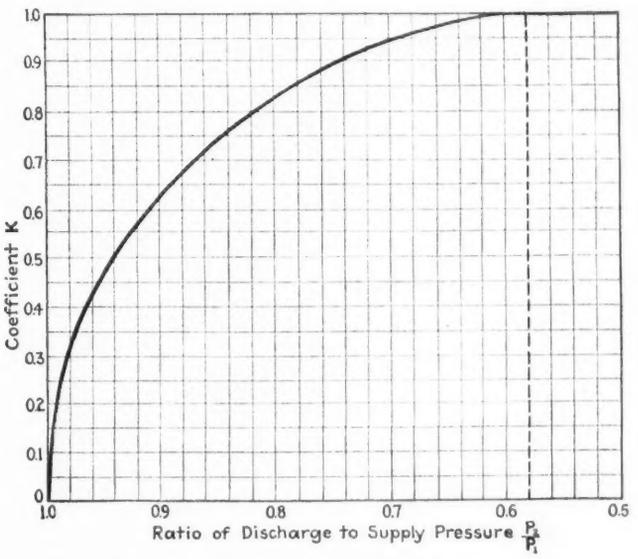


Fig. 1—The coefficient or constant K varies with the ratio of discharge to supply pressure

Automatic equipment may be installed to regulate the

pressure differential according to outside temperatures, but in large buildings where a capable operating engineer is on duty at all times it is possible to operate equally as well and possibly better in some cases by manual control of the heating system pressures.

Remote Indicating Thermometers Needed in Manual Controlled System

In the cases where pressures are regulated manually it is essential that the engineer have means for knowing accurately the outside temperature, wind direction and velocity and a number of inside temperatures. This is also important in systems where the control is automatic. In the last analysis, the purpose of heating is to provide satisfactory inside temperatures regardless of what the outside temperature may be. Automatic con-

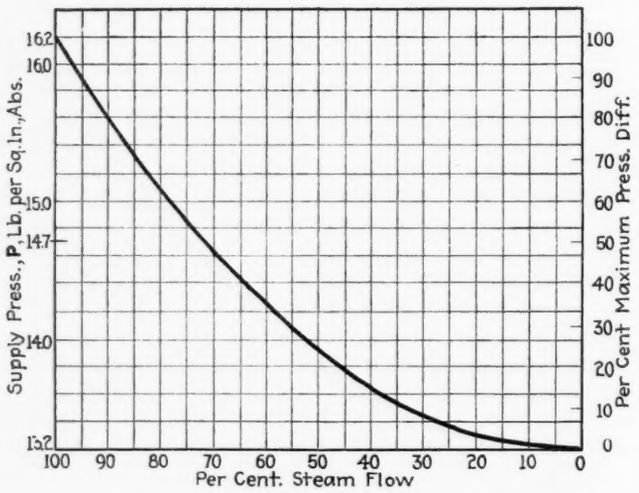

Supply Press., P, Lb. per Sq. In., Abs.
16.2
16.0
15.0
14.7
14.0
13.2
100 90 80 70 60 50 40 30 20 10 0
Per Cent. Steam Flow
100 90 80 70 60 50 40 30 20 10 0
Per Cent Maximum Press. Diff.

Fig. 2—Per cent steam flow at various supply pressures. System designed for 100 per cent flow with supply pressure of 16.2 lb., abs., and return pressure constant at 13.2 lb., abs.

trol systems usually provide means whereby the normal flow called for the outside temperature may be adjusted manually by the operator to care for heating-up periods and abnormal wind conditions.

Electric thermometers may be installed at those points where temperature information is desired and connected to recording or indicating equipment at some central point convenient to the operating engineer. The indications obtained from this equipment are the guide to the engineer, showing the actual performance of the system and governing the adjustments in system pressures.

Where the operating pressure range is established within two or three pounds above or below atmospheric, it is desirable to provide U-tubes or manometers using water to measure the pressures. With these instruments small variations are detected. A pressure change of 1 oz. per square inch causes a deflection in a water column of approximately $1\frac{3}{4}$ in. Such a change would cause a deflection of only $\frac{1}{8}$-in. in a mercury tube, and with a pressure or vacuum gage of the ordinary Bourdon tube type the change in reading scarcely would be noticed. Usually, in the control of a system using orifices, a change in differential pressure of 1 oz. is not important, but the effect of changes of 2 or 3 oz. is noticeable.

Reductions of pressure differentials do not cause proportional changes in flow. Fig. 2 shows the percentage of steam flow corresponding with the percentage of maximum differential required for 100 per cent flow in a system designed to operate with a constant return vacuum of 3 in. of mercury and to give 100 per cent flow with a supply pressure at $1\frac{1}{2}$ lb. per square inch gage, that is, 3 lb. per square inch differential.

In the operation of a system fitted with orifices a schedule should be set up according to outside weather conditions, to indicate the hours at which heating should begin in the morning, the pressures that normally should be carried after the indicated room temperatures have been reached and the time for shutting off the steam at the end of the day. In the coldest weather it probably will be found necessary to carry some reduced steam supply throughout the night to guarantee proper heating the following morning. These are all items that must be determined by experiment for each case separately.

It is often desirable to divide the heating system into several zones, each zone having an individual steam supply. These zones should be arranged so that separate control is possible for the various weather exposures of the building. Improved performance will be obtained if the building can be divided into two or more horizontal zones depending upon the building height. The horizontal zones make it possible to regulate the heating more accurately during the warming-up and shutting-down periods.

It should not be expected that an orifice system will give absolutely uniform temperatures throughout a building such as might be obtained with individual radiator control from thermostats. However, in a large building that is not well zoned it has been possible to regulate the steam supply so that temperatures are maintained within a range between 70 and 75 deg. in different rooms, and within limits of 2 or 3 deg. in a majority of cases, without much attention to the radiator valves by the occupants. Before the system was installed temperatures frequently varied between 70 and 80 deg. Where orifices are used it is possible also to make changes in the orifice size to suit the individual desires of different occupants as to room temperatures.

Orifice Reduced Steam Consumption

In the building referred to, the orifice installation affected only about one-half of the total equivalent connected radiation, but the reduction in steam consumption by careful operation was approximately 10 per cent. Where steam is purchased on a flat rate irrespective of demand, the money savings will be directly proportional to the percentage of steam saving. If, however, the steam is purchased on a rate combining a demand charge and consumption charge, the percentage of money saving probably will be less than the percentage reduction in steam consumption, because it is difficult to reduce materially the peak demand for steam on extremely cold days. When steam is supplied from a privately owned plant the money saving will correspond to the reduction in fuel consumption occasioned by the decrease of steam requirements.

In many large buildings the annual cost for heating steam will range from $50,000 to $100,000. It is apparent that even a small percentage of this total will represent appreciable savings.

The installation of orifices and control equipment usually is not expensive. The temperature-indicating equipment will be a major item, but without such equipment it is difficult for the operator to control the system intelligently.

. . . RIGHT OUT OF THE PLANT . . .

Manual Starter Changed for Dynamic Braking Service

WHEN it is desired to stop a load quickly that is driven by a direct-current motor, it may be done by connecting the motor's armature to a resistance, while the field coils are excited. Under these conditions the motor is converted into a generator and applies a retarding force to stop the load. This action is called dynamic braking. To use a motor in this way requires special connections in the controller.

A 10-hp. motor started by an ordinary manual-type control was driving a machine that did not stop quickly enough. At first a mechanical or a magnetic brake was considered, but these were expensive and in other ways did not appear to be satisfactory for the job. The next

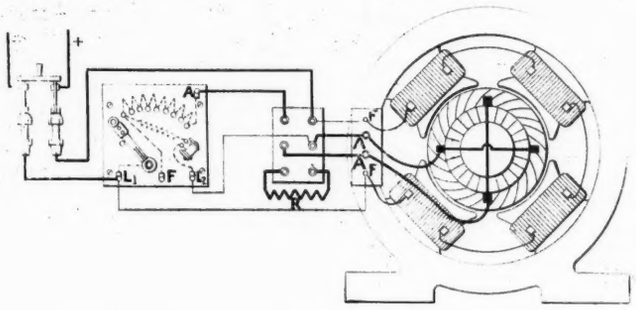


Diagram of connections used to apply dynamic braking to the motor

solution of the problem was to apply dynamic braking to the motor. This seemed to have the desired features for stopping the machine, but the motor starter was not designed for this service. It would require several weeks to obtain a new automatic starter with dynamic braking connections and it was desired to put the motor and machine into service without a long delay. Therefore, it was decided to change the manual-type starter so that it would function in connection with dynamic braking until the proper type of controller could be obtained.

The diagram shows the connection used for dynamic braking. The shunt-field coils were connected so that they would be excited as long as the line switch was closed. A two-pole double-throw switch was mounted on the machine in easy reach of the operator and connected into the motor circuit as shown. A resistance with several taps was connected to the bottom of the switch. The taps were to allow selecting one that would give the right amount of resistance to be connected across the armature terminals to produce the desired dynamic braking effect.

With the double-throw switch closed to the up position the motor can be started in the normal way. Throwing the switch to the down position disconnects the armature from the line and connects it to the resistance R, while the field coils are excited from the line. As long as the armature continues to rotate it will have a current generated in it that will produce a braking action to bring the load to rest.

The intensity of the braking effect can be controlled by adjusting the resistance. The lower the resistance connected across the armature terminals, the more severe will be the braking effect. The limit in braking effect is the amount of current that can flow through the motor without causing severe sparking at the brushes and the mechanical forces the machine will stand without injury.

The way the no-voltage release coil is connected to the double-pole switch makes the coil alive when the switch is in the up position and opens the coil when in the dynamic braking position. This insures that the arm on the starter will be returned to the starting position before the double-throw switch is close to the running side. This method of stopping the motor worked satisfactorily for over two months until a new control was obtained. No doubt there are many places where a similar arrangement could be used satisfactorily in an emergency.

MARIN PHILLIPS.

Niagara Falls, N. Y.

Method of Checking Amount of Air Delivered by Air Compressors

IN THE AUG. 12 number R. H. Parrish gives an account of the closed-tank method of measuring air. I do not wish to criticize his method, which he has found sufficiently accurate for check-up work, but his figures are surely open to question.

In the example he gives, the air tank has a capacity of 4.88 cu.ft. He says "When the gage shows 75 lb. we can assume that the compressor has delivered into the tank $4.88 \times 6.1 = 29.8$ cu.ft. (6.1 being the volumetric ratio at 75 lb. pressure and atmospheric pressure respectively)." This assumption is erroneous. The tank was full of air at atmospheric pressure to start with, and the compressor has delivered into the tank only $29.8 - 4.88 = 24.9$ cu.ft. of air.

A compressor rated at 60 cu.ft. should therefore pump a tank of this size up to 75 lb. gage in 24.9 sec. if the compressed air is exactly at the same temperature as the

of the atmosphere—a condition which seems to me almost unattainable and presupposes a perfect system of cooling.

The temperature of the compressed air in the tank at 75 lb. gage pressure will probably be at least 140 deg. F. higher than the atmosphere, say 200 deg. F. Using the usual formula

$$Va = \frac{Px\,Ta\,Vx}{Pa\,Tx}$$

$$= \frac{89.7 \times 520 \times Vx}{14.7 \times 660} = 4.8\,Vx$$

gives us 4.8 as the volumetric ratio. From this must be deducted the volume of free air originally in the tank. The 60-cu.ft. compressor in question should pump the tank to 75 lb. gage pressure in $(4.8 - 1) \times 4.88 = 18.5$ sec., and not 29.8 sec. as calculated by Mr. Parrish.

The rise in temperature of the compressed air and the consequent decrease in volume seem to me to introduce an unavoidable complexity into Mr. Parrish's simple method. This rise in temperature is influenced by several factors, seasonal changes in temperature, speed of the compressor, efficiency of the cooling system, pressure of compression, and length of time the compressor has been running. If it is certain the tank and piping are air-tight it would be better to run the compressor discharging into the tank for a definite length of time or for a definite number of strokes and wait until the temperature of the compressed air has come back to that of the atmosphere, and then calculate the volume from the gage pressure. The drawback to this method is that a small leak will cause error. On the other hand, to ignore the factor of temperature variation is nothing less than pure guesswork.

E. Scott Rivett.
Noranda, Quebec. Noranda Mines Co., Limited.

Using Heavy Fuel Oil in Solid-Injection Diesel Engines

IN ANSWER to the letter of Howard Livingston on page 994 of the June 24 number under the subject of "Using Heavy Fuel Oil in Solid-Injection Diesel Engines," certain questions were asked which I should like to answer, as follows:

1. No air filters were installed.

2. The nearby air-injection engine had no air filters, but intake air was taken from the inside of the power house. No centrifuge was used.

3. The two De La Vergne engines were operated in parallel for fourteen hours during day time, and one engine alone during the remaining ten hours. Occasionally both engines have to operate in parallel with steam turbines.

4. One unit runs continuously for seven days, while the other runs only fourteen hours a day, this engine alternating every week. The average load on each unit is 60 per cent of the rated load, while the peak loads reach 80 per cent.

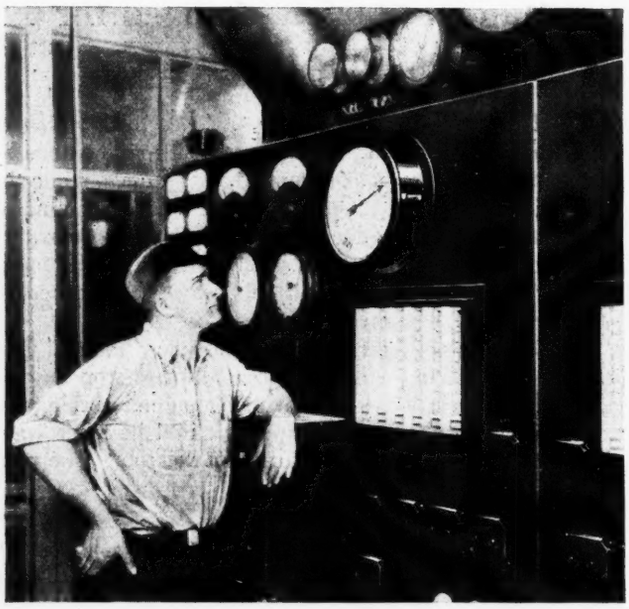
5. With both units in operation, the centrifuge is in almost constant service. With one unit in operation, the centrifuge is used while the day tank is being filled. With the automatic stop shutting down the centrifuge and fuel supply to the tank, the day tanks are filled by automatically controlled fuel-transfer pumps.

A. H. Wirz.
Philadelphia, Pa.

Auxiliary Water Level Gage Increases Safety and Efficiency

STEADILY INCREASING steam pressures are bringing new problems. These pertain to both efficiency and safety, both of which are of interest.

A recent editorial in *Power* calls attention to the problems of boiler water level measurement and cites the case of inaccurate gage glass readings due to difference in density of the water in the gage glass and in the boiler. This, it is said, causes high water levels to be maintained in boilers during normal operation, an undesirable condition. Coupled with that is the potential danger of broken gage glasses. However, codes still require the use of direct-reading gage glasses, so they must remain.



Boiler water level gage on instrument board at operating floor level

Even though gage glasses must be connected for the guidance of the water tender, maximum efficiency results from centralized control. This means that the engineer must have the details constantly before him on the instrument board. Direct indication of steam flow is important, and draft gages, flue-gas pyrometers, and CO_2 meters are necessary for combustion efficiency. There should also be a boiler water level gage, for in modern steam generators the water level plays an important part in the efficiency of the unit.

A reliable manometer, with the pressure chamber and working parts completely separated from the electrical connections, may readily be connected to high-pressure boilers. Then the water level can be transmitted electrically to an indicating instrument on the operating board and to a recorder in the office. The accuracy of these instruments is easily checked. A proof light in the circuit will indicate whether the current is on. The illustration shows such an installation in the Morgan & Wright plant of the United States Rubber Company, Detroit, Mich.

Numerous installations testify to the success of the principle and practice of checking direct-connected gage glasses by electrically transmitted data on boiler water levels. In the operating room the instrument dial takes

the place of shouted reports from the water tender or a tiresome climb to check the gage glasses. The water tender is responsible for maintaining a constant water level, but the fact that he is always subject to check by the operating engineer is a strong incentive to maintaining the water level at the proper point with a minimum of fluctuation.

RALPH BROWNE.

Philadelphia, Pa.

Maintaining Service in Coal and Ash Handling

IN THE article entitled "Maintaining Service in Coal and Ash Handling" in the Aug. 26 number reference is made to coal bunkers, hoppers, silos and to downcomers or chutes from bunkers.

It seems to be assumed that the material for the above is exclusively sheet iron or steel plate, which evidently has to be protected from the corrosive and abrasive action of dry or moist coal as a matter of maintaining service. It is stated that unlined steel bunkers last from four to eight years. However, it is expected that they may last up to fifteen years if the new steel is scraped, cleaned, and covered with acid-proof paint and 2½-in. coating of concrete. It is further claimed that if cracks in the concrete lining, due to impact of the coal or to heat from spontaneous combustion, are not discovered and taken care of, the life of the bunker will be even shorter than if no lining at all had been provided.

Surely acidous solutions from certain coals finding their way to the steel plate through cracks in the concrete lining have a better chance to attack the steel than if such diluted acids were not permitted to concentrate upon certain parts of the steel but were carried off by the sliding coal in the bunker, provided, of course, that the proper design of the bunker would keep all the coal active and gravitating toward the outlets from the bunker.

However, most frequently it is not the impact of coal or spontaneous combustion that cracks the concrete lining, but the breathing of the steel-plate bunker, due to its flexibility, which responds to the varying loads. The deformation of an ordinaary steel bunker of catenary or parabolic design may vary its low level by a couple of inches as the empty bunker is being filled with coal.

How can the cracking of the concrete lining be prevented under such deformation? No doubt this must be the reason why steel bunkers are rarely lined, even though, according to records, they may last only four to eight years.

With a view to protection from corrosion, it would appear more logical to build coal bunkers of reinforced concrete. These, however, should have at least 6-in. walls, and these would be too heavy in many cases. Also, to build them in efficient designs for discharge would require expensive form work. Furthermore, they could not be repaired readily and could be neither extended nor salvaged. Evidently, concrete units are not the popular solution for durable and well-designed coal bunkers.

Cast-iron coal bunkers in sectional construction and of efficient design seem more logical, for the following reasons:

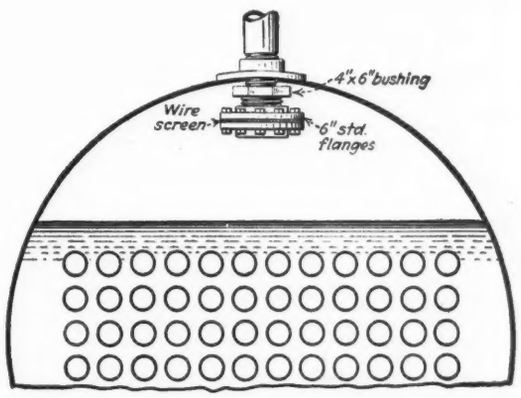
The component sections being unmachined, the dense and somewhat chilled skin of any casting presents a practically indestructible surface to corrosion and abrasion as occur in coal bunkers. Consequently, neither bitumastic coating nor concrete lining is required for protection. Since the structural-steel framework is depended on to carry the load, the component sections are reduced in thickness to about ⅜ in., so that the weight of a cast-iron bunker is only slightly greater than that of a corresponding steel-plate unit. The framework permits convenient erecting and dismantling of the sections in a cast-iron bunker. Also, agitators and access doors can be placed where most likely required much more easily in the cast-iron sectional construction than would be possible in either steel plate or concrete.

Divorcing the handling of coal and ashes is gaining increasing approval. However, the problem of protection against corrosion and abrasion in the case of ash handling is even more important than with coal. In contrast to dry or moist coal, ashes are being quenched usually beyond their limit of saturation. The nonabsorbed moisture and drips would destroy unlined steel plate and get behind a concrete or brick lining in a short time. Cast iron has proved a logical material for ash hoppers as well. But because, before quenching the hot ashes, temperatures may be set up that will damage cast iron, a refractory lining is desirable.

Easton, Pa. E. HAHN.

Improvised Dry-Pipe for Return-tubular Boilers

SOME TIME AGO two return-tubular boilers that were considerably overloaded gave priming trouble. The main steam outlet pipes were 4 in. in diameter. Separators were installed on each boiler outlet pipe ahead of the engines, but more than once the separators were flooded and some water reached the engine cylinders.



Shows device attached to steam outlet

By way of experiment the thread on one end of a 4-in. nipple was cut deeper and screwed into the outlet flange. This appeared to help some, but was not a cure. Then a 4x6-in. bushing was screwed on the nipple. This was followed with a 6-in. flanged coupling with a piece of heavy screen wire between the two flanges, as shown. This simple device could be put on or taken off in a few minutes, and was made from material on hand. It completely eliminated the trouble.

J. E. NOBLE.

Toronto, Ont.

From Among Readers' Problems

Conducted by

L. H. MORRISON

PISTON PRESSURES BY THE INDICATOR—*A fellow engineer claims that the indicator diagram does not give a real picture of the work done on and by the engine piston. Is this true?* C.R.F.

Theoretically the statement is correct. For example, on the exhaust stroke of a steam engine the steam is forced out through the exhaust connections at a high velocity. If the engine has a high piston speed the steam velocity in cylinder is also considerable. The indicator diagram shows the cylinder pressure but the force transmitted from the flywheel to the piston must equal this potential energy plus the kinetic energy needed by the steam to produce the high velocity of exit. Consequently the work done on the return stroke is greater than indicated by the diagram. However, the error is of no moment in the actual engine.

FACTOR OF EVAPORATION—*What is the factor of evaporation when the steam pressure is 105 lb. gage and the feed water enters at 220 deg. F.* P.P.S.

To evaporate a pound of water at 212 deg. F. into steam at 212 deg. F and zero gage pressure, 970.2 B.t.u. are required. If the steam in the actual boiler is at 105 lb. gage, 1,189.8 B.t.u. must be added if the feed water is at 32 deg. F. But since the feed enters at 220 deg. F., it will contain 188 of this amount, so that the net addition is 1,189.8 — 188 = 1,001.8. The factor of evaporation is then 1,001.8 ÷ 970.2 = 1.0333. In other words the evaporation of a pound of water from 220 deg. F. water into saturated steam at 105 lb. gage is equivalent to evaporating 1.033 lbs. from 212 deg. F. feed into steam of 212 deg. F. and zero gage.

SUBMERGENCE FOR AIR PIPE—*With an air-lift pump for raising water from a deep well, what is the best depth for putting down the air pipe?* P. B. A.

No formula can be given for determining the best depth for putting down the air pipe, on account of the variation in combination of the conditions found in different cases, and more especially when there is uncertainty of the amount of drop of the ground-water level during the operation of pumping.

Under favorable conditions good results have been obtained with deep wells when the depths of submergence (or distance from the level of the ground water when operating, down to the point where the compressed air is released) is about 60 per cent of the total air lift, measured from the foot of the air pipe up to the level of the point of discharge from the water pipe. The best submergence under any particular set of conditions should be determined by experimenting before details of an installation are made permanent.

A Question for Our Readers

THE 500-hp. diesel plant in which I am employed seems to cause severe vibration to surrounding buildings, and the owners of the buildings are complaining. The formation under the engine foundation consists of three feet of soft sand, six feet of quicksand, two feet of gumbo clay, more quicksand and another layer of clay, continuing this way until solid bottom, a bed of shale, is reached at 66 ft. This foundation has no piling under it. The vibration seems to be just as severe three or four blocks from the powerhouse as it is at the plant.

How can the trouble be remedied? Would putting a false wall around the engine foundation down to the clay help overcome the trouble? It seems the quicksand's working is what causes the trouble.

Suitable answers from readers will be paid for and published in the Nov. 11 number

SIZE AND NUMBER OF SAFETY VALVES—*Our 200-hp. boiler operates at 125 lb. pressure but we plan to drop the pressure to 15 lb. Will the same safety valves be sufficient?* P.L.T.

The A.S.M.E. Code in Paragraph P-274 Revised states that the minimum relieving capacity of safety valves shall be based on: 6 lb. of steam per square foot of heating surface for water tube boilers. For all other power boilers using over 100 lb. pressure it shall be 5 lb. of steam and 3 lb. for boilers of under 100 lb. pressure.

Let it be assumed that the boiler is of the fire tube type and has 2,000 sq.ft. of heating surface. This would call for a relieving capacity of 2,000 × 5 = 10,000 lb., and by the A.S.M.E. Code two 4-in. valves are required.

If the pressure is dropped to 15 lbs. the relieving capacity becomes 2,000 × 3 = 6,000 lb., and the Code calls for three 5-in. valves or four 4½ in. valves.

But in any case, the safety valve capacity must be such that the valve will relieve the boiler when the latter is at maximum output, with no more than a 6 per cent pressure rise.

AVERAGE POWER FACTOR—*What is the average power factor of a 3-phase, 220-volt circuit, with 80 to 1 ratio transformer, when the difference in the watthour meter readings, for a given period, is 96 and the difference in the readings of the reactive-voltampere meter, for the same period, is 53?* W.R.

The average power factor may be calculated from the formula:

$$P.F. = \frac{W}{\sqrt{W^2 + W_1^2}}, \text{ where } P.F.$$

is the average power factor, W the watthour meter reading and W_1 the reactive voltampere meter reading. Then in this problem is:

$$P.F. = \frac{96}{\sqrt{96^2 + 53^2}} = \frac{96}{109} = 0.88$$

It is possible that the power factor of the different phase may vary somewhat from this value.

LAYING UP STEAM TURBINES—*We have two impulse turbines which are operated condensing. Having arranged to purchase, what should be done in laying up the turbines to stand by in good condition, ready to start when needed?* R. E. R.

When the turbines are shut down and drained, pour about one-half gallon of engine oil in the cylinder of each turbine

while it is slowly turning over, and work the oil through the cylinder to coat the blading, packing glands and other finished parts. Care should be taken that the turbines are completely disconnected from any live or exhaust steam line. To guard against rust or damage from such connections, close the throttle valves and provide bleeders outside of the valves with independent openings to the atmosphere. Any drains connected with other drips should be disconnected close to the machines, and the drain pipes should be blanked off to prevent steam from backing up to the turbines.

After all finished parts have received a doping of thick oil, provide the turbines with tarpaulins or canvas coverings to protect them from dust.

PREVIOUS QUESTION

Discussed by Readers

THE QUESTION

IF THE engine exhaust can be used for feed-water heating, is a motor or engine drive the best for stokers? At present we are feed heating from a 4-lb. turbine extraction line. C. DE L.

ASSUMING that the supply of steam from the 4-lb. turbine extraction line is ample for the amount of feed-water to be heated, the motor-driven stoker is to be preferred from the standpoints of efficiency, ease of operation and maintenance cost.

The power necessary to drive the stokers can be generated so much more efficiently in the main turbine than in stoker engines that, even allowing for the losses in the necessary transformers, motor-generator sets and in the motors themselves, the plant efficiency would be higher with the motor-driven stokers.

From an operating standpoint, the motor-driven stoker can be started and stopped more easily than an engine-driven stoker. In adjusting stoker speed, the motor-driven stoker has certain definite speeds at which it may be run, while an engine-driven stoker can, at least theoretically, be adjusted to any desired speed. By making arrangements so that auxiliary power can be obtained from outside sources, the motor-driven stoker can be operated when all boilers are dead.

Maintenance on the engines, with their many moving and wearing parts, and the maintenance on the steam lines would be higher than the maintenance on the necessary electrical equipment.

Finally, if exhaust steam from the engines were to be used for feed-water heating in an open heater, it would be necessary to install a separator to remove all the oil from the steam before going to the heater.

WESTON A. BROWN,
Philo, Ohio. Ohio Power Co.

A MOTOR will in all probability prove to be the most satisfactory stoker drive under the conditions described. Maintenance will be considerably less on a motor installation than on a steam engine drive and the quality of operation will be higher.

Steam engine drives are subject to many mechanical ills in connection with the numerous moving parts and friction surfaces. On the other hand, electric motors, particularly the induction type, give a trouble-free performance that is unequaled by any reciprocating type of prime mover.

The economy secured by the present utilization of the engine exhaust for feed-water heating will be partly balanced in the case of the motor drive by the fact that more steam can be bled from the turbine when the engine exhaust is abandoned.

Without doubt the investment will be larger for the motor, with its necessary breaker and controller. Nevertheless, taken from all angles, the motor looks like the best thing for the job. All the foregoing is dependent on the assumption that the turbine generates the power that would run the mtor. If the power is purchased it might be a different story, in which case the price paid for the power would be the deciding factor. JOHN W. WALDENVILLE.
Pittsburgh, Pa.

IF ALL the exhaust from an engine is needed and can be used for feed-water heating, it is a satisfactory and economical drive for stokers, and I think would be better than a motor drive.

An engine for driving stokers is generally supplied with a governor and runs at a constant speed regardless of the varying power required by the stoker, the amount of coal used being regulated by a gear change box and other adjustments on the stoker; in this respect the operation is similar to a constant-speed motor drive.

It is better to use a separate drive for the stokers of each boiler, so that in case of several boilers being shut down it will not be necessary to use an engine or motor large enough to drive a whole group of stokers when only one set is being used.

In case there is enough exhaust steam to heat the feed water without the exhaust from the stoker engine, it would be more economical to use a motor drive. The average boiler room is generally a dusty place for a motor, but this can be taken care of by protecting it as much as possible and by cleaning and blowing the dust out of the motor at regular periods.

Very frequently in power houses the main circuit breakers are opened by overload. This will cause the motor driving the stoker to stop, and that is inconvenient when there is a large demand for steam.

In the case of power being furnished by one generator the motor can be connected inside the main circuit breakers and would not be affected by their opening. But in the case of two or more generators being operated in parallel it is better to use a set of auxiliary busbars connected inside of the main circuit breakers. Power for all motors, such as feed pump, blower and stoker, should be taken from these busbars.

Any generator that is in operation can be connected to the auxiliary busbars. But it is better to connect only one generator at a time, providing it has capacity enough to operate the motors. WM. H. COFFIN.
East Hartford, Mass.

WHETHER a motor or an engine should be used for stoker drive is so broad a question that certain assumptions must be made to answer it.

Assuming that all of the exhaust steam from the engine can be used at all times without displacing or reducing the extraction steam, the engine should be used, because the economy would be better and the flexibility of speed would be highly desirable.

On the other hand, if any appreciable quantity of exhaust steam would have to be wasted to the atmosphere or any appreciable reduction in extraction steam would result, it would be wiser to use a motor for the stoker drive and obtain flexibility by variable-speed devices or special variable-speed motors.

If the extraction line were not being used to capacity of the load carried and further load could conveniently be carried by main turbine, the addition of a motor load for stoker drive would probably furnish all of the additional steam required for heating and yet have it controllable when not needed.

Such conditions as type of load, engine, motor and the size and economy of main unit will have so much weight in deciding individual cases that it is hard to answer definitely with the data given. R. S. LANE,
Mechanical Engineer,
Pocahontas Fuel Company, Inc.
New York City.

THE ENGINEER'S B

Calculating Costs

COST FINDING FOR ENGINEERS. *By Charles Reitell and Clarence Van Sickle. Published by the McGraw-Hill Book Company, 370 Seventh Ave., New York City; 1930. Cloth 6x9 in.; 518 pages. Price, $5.*

THIS VOLUME has been written with the definite purpose of providing a text book for engineering students who are beginning the study of cost accounting. Only such principles as are fundamental to factory cost accounting are emphasized.

The book is presented in five parts; the first treats of accounting technique, the second is on basic valuation principles, the third on factory controls, the fourth deals with revenue accounts and the last contains problems whose solution illustrates the principles discussed in the text.

Although its greatest value is to the industrial engineer and executive it nevertheless contains much that should be of interest to the power executive. For him those portions dealing with accounting for depreciation, reserve funds, closing the operating accounts and valuation of fixed assets should prove of value.

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Welding Practice

WELD DESIGN AND PRODUCTION, WITH PARTICULAR APPLICATION TO SAFETY AND COST. *By Robert E. Kinkead. Published by the Ronald Press, 15 East 26th St., New York City; 1930. Cloth, 6x9 in.; 108 pages, 54 illustrations. Price, $4.*

IN POINT OF VIEW and method of presentation, this book is decidedly unusual. Mr. Kinkead's knowledge of welding fundamentals, gained through many years of investigation and practical experience, gives assurance that the content of this book is as sound as its method is attractive.

Throughout the volume, but particularly in the introductory chapter, the author gives expression to his philosophy of business. He treats business and manufacturing problems in terms of the theory of probability, and shows how this enters into every business decision, consciously or unconsciously.

Looking at welds from this point of view, Mr. Kinkead discusses the possibilities of failure, and evaluates these possibilities in terms of the particular application. It is his belief that by proper procedure control and design, welds having any desired degree of reliability may be obtained.

Another very interesting and valuable feature of Mr. Kinkhead's presentation is his use of rubber models to illustrate the actual distortion that takes place in welded steel specimens subjected to stress. By the use of such models he is able to illustrate complex action without recourse to mathematics.

Following are the titles of the various chapters:

Prediction in Manufacturing, Why Welds Are Made, How Welds Are Made, Effects of Physical Conditions on Weld Behavior, Reproductions of Weld Sections, Actual Welding Conditions, Welding Procedure Control, Machine Welding, Research and Development, Summary.

"Weld Design and Production" is directed primarily at two groups: Engineers who are responsible for satisfactory and safe welds, and business executives who are responsible for the cost element of welding jobs.

✦

Oil Circuit Breakers

HIGH-VOLTAGE OIL CIRCUIT BREAKERS. *By Roy Wilkins and E. A. Crellin. Published by the McGraw-Hill Book Company, 370 Seventh Ave., New York City; 1930. Cloth, 6x9 in.; 301 pages, 15 tables, 121 illustrations. Price, $4.*

THE AUTHORS have decided the text into four parts: history, theory and discussion, modern high-voltage breakers, and field tests. Water has long been considered something to be avoided in oil circuit breakers, yet in the earlier type of breakers a combination of oil and water was used because it was believed that oil only would interrupt the circuit too abruptly. This is only one of the interesting developments related in the historical part of this book.

Throughout the text the authors have viewed the subject from the operating angle and have laid bare the shortcomings of oil circuit breakers. This is particularly true in Part II, where the theory of oil circuit breakers is discussed. The many factors affecting oil-circuit-breaker operation are considered and attention is called to the lack of fundamental knowledge on which to base their design and to judge their performance.

In Part III is given a general description of the high-voltage oil circuit breakers built by the different manufacturers. This section in addition to giving detailed information on the different makes includes a table in which the types are compared according to rating, physical characteristics, tanks, bushings, contacts, operators and operating characteristics. Part IV discusses the field tests that have been made on oil circuit breakers and gives the results in tabulated form.

The treatment throughout the work is practical and for the most part mathematics have been omitted. Anyone interested in oil circuit breakers will find that this book fills the need for a comprehensive treatment on the subject.

Mathematics

MATHEMATICS FOR ELECTRICIANS. *By Martin H. Kuehn. Published by the McGraw-Hill Book Company, 370 Seventh Ave., New York City; 1930. Cloth, 5½x8 in.; 220 pages, 64 illustrations. Price, $1.75.*

A MAJOR PORTION of this book is devoted to algebra and its application to electrical problems. The mathematical principles are demonstrated by numerous examples and then these principles are applied to solving, Ohms laws, series-circuits, parallel-circuits, power, generator and motor, battery and Kirchoffs laws problems. Two chapters treat of plane trigonometric functions and fundamental alternating-current circuits.

The book is fundamentally a text for vocational school, but those who wish to renew their acquaintance with algebra and electrical problems will find this book useful.

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Growth of Business

AMERICAN INDUSTRY AND COMERCE. *By E. Dana Durand. Published by Ginn & Company, 70 Fifth Ave., New York City; 1930. Leather; 637 pages. Price, $4.*

ONE of the most difficult types of writing is that of presenting dry statistics in such a way as to hold the interest of the average reader. Few writers ever attain this ability to make figures live. In this treatise Dr. E. Dana Durand, statistical assistant to the Secretary of Commerce and former director of the United States Bureau of the Census, has attained an enviable position as an interpreter of data in the interest of the average reader. Few who take up this book will lay it down until several chapters have been covered, and then it will only be laid aside for a more convenient moment.

The author drawing upon his long statistical and economic experience in American industry and commerce through his contact as a government official, presents a vivid picture of the development since the founding of the nation and especially during the present century. Special stress has been laid upon international comparisons, upon the interrelation of the various economic activities, and upon the general course of recent economic development. The earlier history of industry and commerce is traced only in broad outline, since various other works have covered that field. The trends since

BOOKSHELF

the beginning of the present century are discussed with greater fullness; they are the more significant because the forecast elements are largely of a continuing character, so that economic movements for some time to come are likely to be in the same direction.

The author has relied almost entirely upon authoritative statistical publications for his basic facts. Using these facts Dr. Durand paints a continuing picture of the present riches of the country, the character and magnitude of its industries and commerce, and the history of its material development. He seeks to discuss the basic causes of American prosperity and progress, and finally undertakes to discuss the relation of the general economic status and trends of the country to the well-being of the masses of the population.

Reviewed by ROBERT M. DAVIS.

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Material Design Data

STRENGTH OF MATERIALS, PARTS I AND II. *By S. Timoshenko. Published by D. Van Nostrand Company, 250 Fourth Ave., New York City; 1930. Cloth, 6¼x9¼ in. Part I, 368 pages, illustrated; price $3.50. Part II, 333 pages, illustrated; price, $4.50.*

TODAY, the value of a design depends upon reduction in material and costs. While this statement is of interest primarily to designing engineers, power engineers are sometimes confronted with problems involving factors of materials, stresses, and costs. Though these volumes may prove of little interest to the practical engineer interested primarily in maintaining steam pressure or power load, they will prove a decided boon to the engineer with a mathematical turn of mind who wishes to have at hand authoritative ready reference works on mechanics.

Mr. Timoshenko, professor of mechanical engineering at the University of Michigan and nation-wide authority on mechanics, is the author of these two volumes. The first, "Elementary Theory and Problems," contains principally material usually covered in college courses in the subject, while the second, "Advanced Theory and Problems," is devoted primarily to the new developments of practical importance in the subjects of strength of materials and theory of elasticity. Derivations in Part I are simplified as much as possible and this has permitted the introduction of some problems of a more advanced character.

In Part II, complete derivations are given in most cases for the problems of practical importance, but even for the most complicated practical problems where derivations are omitted, complete working formulas are provided for the solution of the problems themselves. These new methods make possible the substitution in advanced work of accurate methods of calculation for the older empirical formulas, with consequent reductions in weight and cost.

Each of the two volumes contains an author index and a subject index, and Part I contains a number of problems with answers for checking purposes after each chapter. The volumes are written in understandable style, and present the divisions of the subject of mechanics in logical sequence.

Reviewed by E. J. TANGERMAN.

Fuel Handbook

TECHNICAL DATA ON FUEL. *Second edition. Edited by H. M. Spiers. Published by the British National Committee, World Power Conference, 63 Lincoln's Inn Fields, London, England; 1930. Cloth, 7½x5 in.; 242 pages, 149 tables, 41 diagrams. Price, $3.12.*

AS A REFERENCE BOOK this volume will be of value to engineers. It contains a great mass of data in tabular and curve form. The title of the book, however, is misleading as less than half of the book deals with data pertinent to fuels. Such subjects as pyrometers, steam, refrigerants, thermal conductivity and metals and alloys are treated in separate sections, and the data relating to them forms a considerable portion of the book. These subjects do not seem to fall under the heading fuel data, and, it would seem, do not belong in the volume. It is unfortunate that a more descriptive title was not used for this data book.

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Brief Reviews

HEAT TRANSFER IN AMMONIA CONDENSERS, PART III. By Alonza P. Kratz, Horace J. Macintire, and Richard E. Gould. Published as Bulletin No. 209 by the Engineering Experiment Station, University of Illinois, Urbana, Ill. Paper, 52 pages, illustrated; free.—Containing a report of progress made in the investigation of heat transfer in various types of ammonia condensers since the publication of Bulletins 171 and 186; the present bulletin covers the results obtained from a study of the performance of a horizontal shell-and-tube condenser.

FIVE YEARS OF RESEARCH IN INDUSTRY, 1926-1930. Compiled by Clarence J. West. Published by the Division of Engineering and Industrial Research of the National Research Council, 29 West 39th St., New York City. Paper, 91 pages; price, 50c.—A reading list of selected articles from the technical press, covering every phase of engineering and industrial research during the past five years.

COAL IN 1928. By F. G. Tryon, O. E. Kiessling and L. Mann. Published as Part II of the "Mineral Resources of the United States, 1928," by the Bureau of Mines. Paper, 174 pages, charts and tables. For sale by the Superintendent of Documents, Washington, D. C.; price, 30c.—A review of the coal industry in 1928, with complete statistics on the production, distribution and consumption of coal during that year.

SECOND WORLD POWER CONFERENCE GENERAL REPORTS. Published by the VDI-Verlag G.m.b.H., Dorotheenstr. 40, Berlin NW 7, Germany; in French, German and English editions. Cloth, 264 pages; price, RM 26.—Contains the general reports of the 34 sections of the World Power Conference held in Berlin last June, and short abstracts of all the papers presented at the sessions.

REPORT OF TEST BY THE DIRECTOR OF FUEL RESEARCH ON THE BABCOCK LOW-TEMPERATURE CARBONIZATION PLANT INSTALLED AT THE DUNSTON POWER STATION OF THE NEWCASTLE-UPON-TYNE ELECTRIC SUPPLY COMPANY. Published by the British Department of Scientific and Industrial Research, 16 Old Queen St., Westminster, S.W.1, England. Paper, 30 pages, charts and tables; price, 9d.—Results of tests conducted on June 25 to 30, 1929.

THE ELECTRIC LIGHT AND POWER INDUSTRY. Statistical Bulletin No. 6, June, 1930, published by the National Electric Light Association, 420 Lexington Ave., New York City. Paper, 11 pages, charts and tables.—Statistical information on the public utility light and power industry for the year 1929, showing growth since 1922.

OPERATING RESULTS WITH THE RECENT EXTENSIONS AT BARTON POWER STATION. By H. L. Guy and H. C. Lamb. Special publication No. 7485/2-1 of the Metropolitan-Vickers Electrical Company, Ltd., Trafford Park, Manchester, England. Paper, 40 pages, illustrated, charts and tables.—Reprint of a paper read before the North Western Branch of the Institution of Mechanical Engineers on March 20, 1930.

New Alloys, Welded Boilers and X-Ray Testing Feature National Metal Week in Chicago

DURING the week of Sept. 22, the attention of the metal world was focused on Chicago where the Twelfth National Metal Congress and Exposition were being held at the Stevens Hotel. Under the sponsorship of the American Society for Steel Treating, holding its twelfth annual convention, several other societies interested in metallurgical and mechanical engineering participated in the congress, each society holding its specific meeting separately. The organizations participating were the American Welding Society, the Institute of Metals, the Iron and Steel Divisions of the American Institute of Mining and Metallurgical Engineers, the Iron and Steel and Machine Shop Practice Divisions of the American Society of Mechanical Engineers and the International Railroad Master Blacksmiths' Association.

Nickel-Copper-Chromium Cast Iron

In an extensive program presented by the American Society for Steel Treating was included a paper of particular interest to the power-plant field, dealing with corrosion and heat-resistant nickel-copper-chromium cast iron by J. S. Vanick and P. D. Merica of the International Nickel Company. Although highly resistant to corrosion and heat, the new metal is of low cost and is easily machined, its characteristics being very similar to those of plain cast iron. It is being used extensively for pumps and pipe fittings handling crude oil and salt water, and also for furnace parts and electrical and signal fittings. Field service parts, under a variety of conditions, have confirmed in general the results of laboratory tests in establishing a greatly increased service life for this material as compared with plain iron, and a life comparable in many cases with bronze.

Being in general quite similar to cast iron in characteristics and in fabricability, the new metal can be produced in the ordinary cupola, and can be molded, cast and handled in the foundry and machine shop under conditions similar to those in practice for plain gray iron. It may be cast, machined and welded although modifications of cast-iron practice are in some cases necessary.

In the program of the American Welding Society, a number of interesting papers were presented dealing with the examination of welds by different methods. That examination of welds by the X-ray diffraction method now under investigation by the American Bureau of Welding gave fundamental information of value in supplementing metallographic processes was claimed in a paper by Prof. John T. Norton of the Massachusetts Institute of Technology. While extensive use had been made of X-rays by the radiographic method, the diffraction method had been neglected. It yielded two important classes of information: first, the arrangement or grouping of the atoms to form the solid state, and second, the granular structure—the size and orientation of the crystal grains. Upon this structure depends largely the physical properties important in welding, such as strength, ductility, and resistance to deformation.

The paper dealt with the pinhole method of X-ray diffraction. X-ray pictures accompanied by photomicrographs of the same areas were presented to show the change in structure at different distances from the joint. In these views the existence and distribution of deformation in the metal was clearly shown.

Use of gamma-rays from extremely small quantities of radium emanation sealed in small capsules as a means of examining heavy welds and castings for internal defects, was suggested in a joint paper by R. F. Mehl, G. E. Doan and C. S. Barrett. Instead of the elaborate apparatus used for X-ray examinations, all that is necessary is a capsule about the size of a 22-calibre cartridge which could be used easily in complicated steel framing or even under water. This capsule is supported in front of the weld and a photographic film in an envelope is fastened behind the weld.

These gamma-rays are of much greater power than X-rays and will penetrate a much greater thickness of metal, say 12 in. as compared with 3 in. The capsules might be rented from hospitals, and as the rays are emitted in all directions, a number of specimens may be arranged around the capsule and photographed simultaneously.

New developments in the magnetic method of testing butt welds were reviewed by T. R. Watts of the Westinghouse Electric & Manufacturing Company. The tests were made by bridging the welded seam with a large horseshoe electro-magnetic and "exploring" the magnetic field in the vicinity of the weld with a meter. This is really a further development of the method devised by M. Roux, a French investigator, to explore the weld by placing iron filings on a piece of paper over the weld and observing the density of the filings as they are affected by the density of metal in the weld. This method, however, is good only when the surface is smooth and the faults are not too far below the surface.

By passing the meter over the weld and watching the pointer, the quality of the weld can be determined. The meter indicates the reluctance of the weld by "reading" the magnetizing forces across the weld as compared with the magnetizing forces of the steel plate. If the magnetizing forces are about the same, the weld is good; if not, the weld is bad, and the meter will tell just how bad it is. This method is practically indifferent to the depth of the fault below the surface and is only slightly affected by a rough uneven surface. In the near future, it is anticipated that both the "iron-filing" and test-meter methods will be used at the East Pittsburgh works of the Westinghouse company on large butt welds in structures such as generator frame rings, flywheel rims and welded pipe.

Conclusions of the paper were that the meter method is more quantitative and more nearly free from personal judgment than the Roux method of using filings; also, that it is as practicable and reliable as any other non-destructive test method, although precise predictions of strength are not to be expected. On the other hand, magnetic testing for other than butt joints does not promise much success.

A study of welded metals under fatigue test was summarized by G. E. Thornton of the State College of Washington. The paper outlined a series of investigations made to determine the endurance limit of butt joints, made by the different welding processes. The endurance limit was determined in the usual way by varying the stress. Range of cycles varied from several thousand to forty million.

Physical Testing

Results obtained made it apparent that welded specimens from fire box steel do not equal the endurance limit of that material unwelded. The three main reasons were: non-homogeneous structure due to oxide spots and pits caused from gas inclusions, difference in grain structure between the metal in the weld and the metal in the original bar, and difference in hardness between these metals. Commenting on the reasons for weakness in the weld, the author stated that the presence of the small holes in the metal was not so harmful as usually supposed unless they were in sufficient number to materially reduce the area of the cross-section of the piece. The oxide spots and pits caused from gas inclusions during the welding operation never could be overcome by treating the weld. Further study is necessary along the lines of shielding the arc by gases or other means in order to eliminate this objection and increase the endurance limit of welded steels. Grain structure and hardness may be overcome by proper heat treatment. The heat treatment of

the weld also will help to eliminate the locked-up stresses in the bar which have occurred in the welding operation. It was pointed out that in certain cases these stresses have been determined as high as 25,000 to 35,000 lb. per square inch. When stresses of such magnitude were considered in conjunction with the bending action of the metal in the rotating beam in which were present forces in tension, compression and shear, the author made it evident that the determination of stresses in untreated commercial welds never could be determined accurately.

Cost of Welding

Under present systems of estimates and accounting, the ultimate economic value of welded products is highly indefinite, according to Robert E. Kinkead, consulting engineer of Cleveland, in a paper on the "Cost of Welding." Most of the so-called "cost" figures were merely indicators of cost. The factor obtained by adding labor, material and overhead is an indicator of this kind. Absolute costs in an economic sense involved service behavior and life of the product. For example, in some cases welded vessels had failed and had been repaired frequently in service, while other similar vessels had continued in service without failure. Tests made by Professor Moore of the University of Illinois had shown that pressure vessels welded in one way may have a life of 5,000 cycles, while with similar vessels welded in some other way, the life is raised to 400,000 cycles. It is obvious that a purchaser would be willing to pay considerably more for the products of the latter system, with their longer life and the freedom from interruptions and costs due to repairs. The same reasoning applied to welded buildings, industrial equipment and other work. Scientific predictions, urged the author, may be made of service behavior and life, and a factor obtained which may be called the "cost of use." Management was interested in the relative value of this "cost of use" factor as related to competing products or methods. In other words, what was needed was a cost indicator based upon the life or economic value of the product.

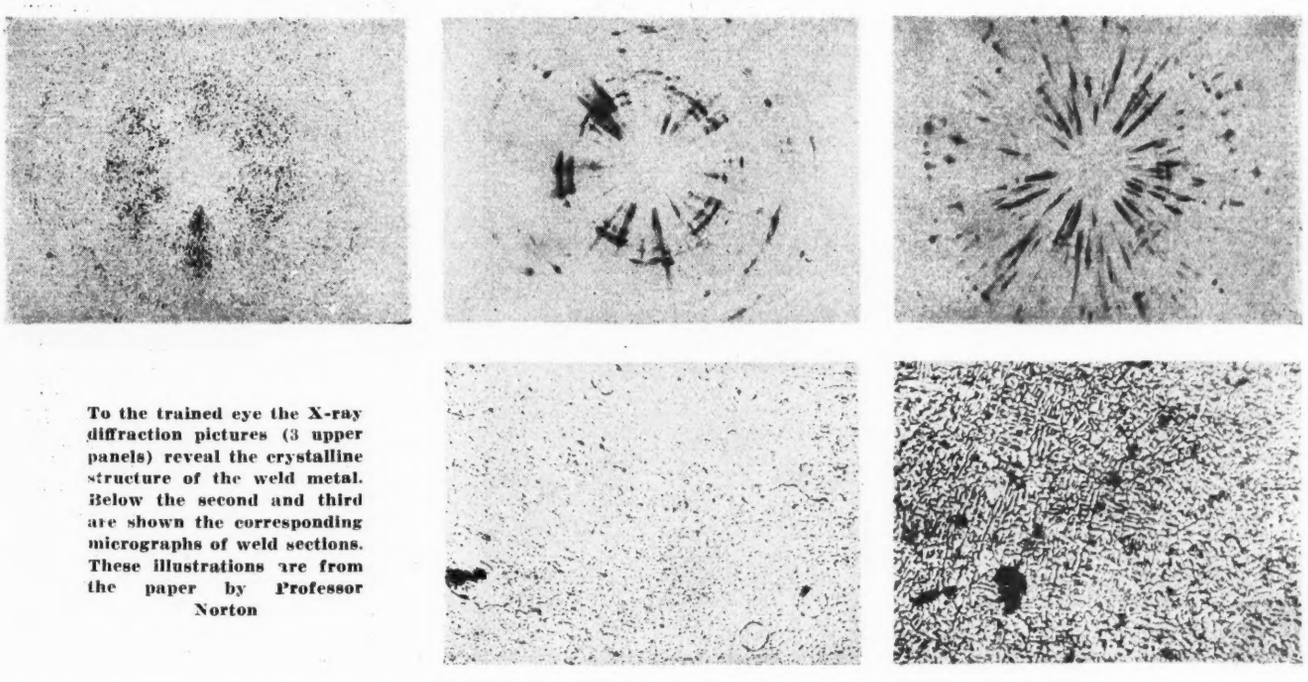
An outstanding contribution to information in the field of pressure vessels was made by J. C. Hodge in his paper on "Applications of Fusion Welding to Pressure Vessels," which reviewed a series of investigations and developments based upon the work of the Babcock & Wilcox Company in this line. According to the author, the two most important factors in metal arc welding which are of the greatest interest at the present time are the quality of the welded joints and the testing procedure to determine the properties and quality of these joints. In discussing these two phases of the subject, the author gave consideration to the properties of welded joints for pressure vessels, macroscopic and microscopic examination, tensile properties, bend tests, impact resistance, laboratory fatigue tests, density and chemical analysis of various weld metals, drum tests and the procedure governing the testing of the finished welded drum to determine the quality of the joint.

Development work on non-destructive test apparatus has been concentrated on two methods: the fissure detection apparatus by electro-magnetic means, and the X-ray method. In testing procedure, the author considered the most important factor to be the non-destructive test or exploration. Securing representative welded samples from each welded vessel, the quality of which would be representative of the quality of the main joints in the drum, presented a serious problem. As an accessory to the physical test specimens, which offered only a means of determining the physical values of samples of the welded joints, the non-destructive test methods gave an examination of every inch of welded joints. Such tests were the only means of examining the entire length of all arc-welded joints in the drum to determine the presence or absence of dangerous defects whether they are serious blow holes, inclusions or cracks. The time may come when the non-destructive test may not be necessary, but for the present and for some time to come, the author considered non-destructive tests as an absolute necessity in assuring the satisfactory performance of a welded joint in pressure vessel service for severe operating conditions.

Symposium on Standard Tests

One of the most active sessions of the convention, prolific with discussion pro and con, was an afternoon meeting devoted to a symposium on standard tests for welds sponsored by the Committee on Standard Tests for Welds of the American Bureau of Welding. The committee had under consideration a revision of the present standard tests for welds. Experience and advancement of the art since the first standards were issued in 1921 had shown the need for this revision. Three standard tests are proposed, namely, tension, bending and shear. Impact tests and fatigue tests are desirable where complete information is wanted, but it was considered doubtful if suitable techniques for these tests had been developed to the point where standard procedures could be proposed.

Speakers assigned to introduce discussions based principally upon actual results from the use of the various standards suggested were as follows: "Tensile Tests for Welds," by J. W. Owens; "Bend Tests for Welds," by W. B. Miller; "Shear Tests for Welds," by Andrew Vogel and presented by R. W. Clark; "Fatigue and Impact Tests for Welds," by C. H. Jennings, and the "Use of Gamma-Rays for Examining Welds," by R. F. Mehl, C. E. Doan and C. S. Barrett.



To the trained eye the X-ray diffraction pictures (3 upper panels) reveal the crystalline structure of the weld metal. Below the second and third are shown the corresponding micrographs of weld sections. These illustrations are from the paper by Professor Norton

Magnetic Testing of Butt Welds*

By T. R. WATTS

Research Laboratories,
Westinghouse Elec. & Mfg. Co.

SEVERAL PUBLICATIONS in French and English have described the magnetic method of testing welds developed by M. Roux, head of the Laboratory of *La Soudure Autogene Francaise.* This method consists of passing magnetic flux through the weld and obtaining a picture of the leakage flux by sifting iron filings onto a piece of paper placed on the weld. These pictures are called "magnetographs" or "magnetic spectra."

The magnetographic method has been employed experimentally by the research laboratories of our company for nearly two years, during which several minor variations and improvements have been developed.

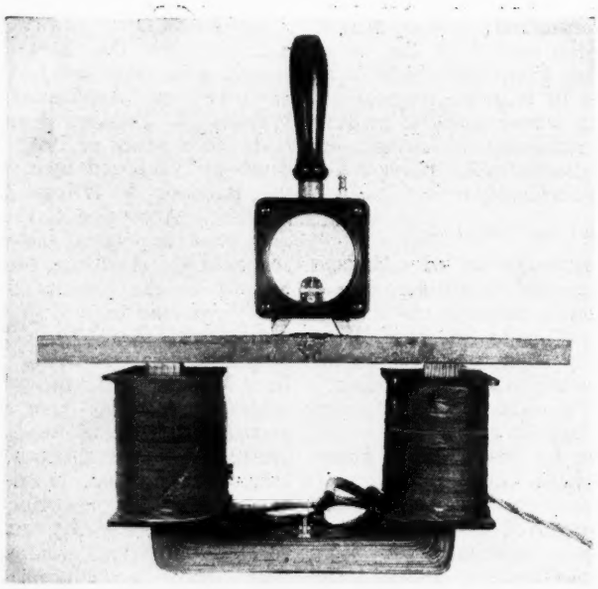
The electro-magnet used for getting a flux through the welded structure is preferably placed on the under side of the welded plate, bridging the weld, and very fine particles of iron are sifted upon a piece of paper laid on the weld. Cracks, blow-holes, poor fusion, or similar faults offer higher reluctance (magnetic resistance) to the flux, and are indicated by a dense collection of fine particles of iron directly over the fault.

The cores of our electo-magnets for weld testing are now built of a stack of strips of silicon-steel sheets, bent into a semi-circular or horse-shoe shape and bolted together only at the middle, leaving the ends of the strips loose and flexible.

We use a very fine iron powder, reduced by hydrogen, principally because it is easily available from chemical supply houses, and is easily distributed uniformly by sifting it from a sort of pepper shaker having very small holes. It is quite satisfactory, but not necessarily better than good iron filings.

If a magnetograph is to be permanently recorded, a piece of blueprint or Van Dyke paper (thin brown-print paper) is used on the weld, and as soon as the magnetograph is formed by the iron powder or filings, a print is made by holding a small portable therapeutic arc-lamp over it, as shown.

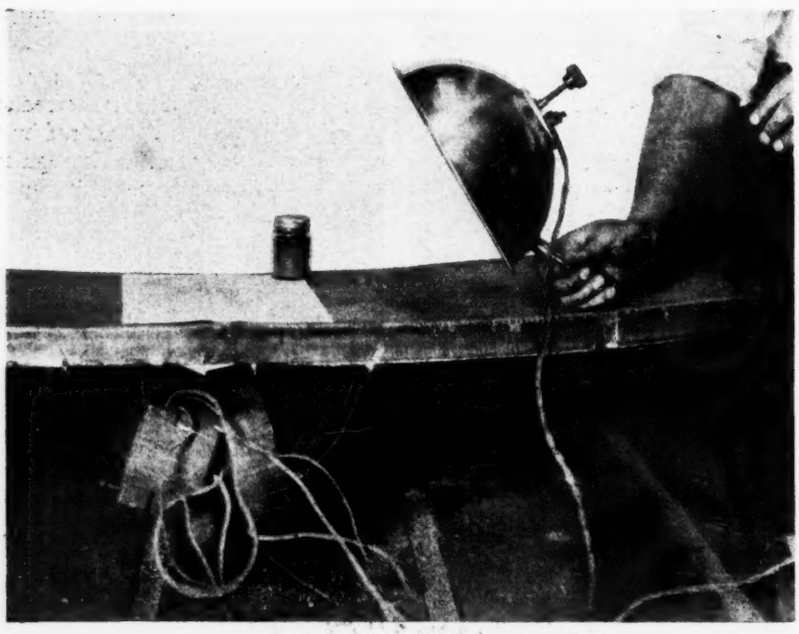
We believe that magnetographic inspection is a valuable means of discovering serious faults, particularly poor fusion, wherever application of the method is feasible.



This instrument measures the reluctance between points where its legs touch

The principle underlying any magnetic weld test method is the fact that faults in welds increase their reluctance, or magnetic resistance. Normally good weld metal deposited by the metallic arc welding process has higher reluctivity than hot-rolled mild steel plate, sometimes as much as four or five times as high at low flux density. However, with increasing flux density this ratio decreases, and at very high flux densities the good weld metal may have a reluctivity nearly equal, or even less than that of the plate. On the other hand, poor welds do not decrease their relative reluctance so much with increasing flux density, and very bad welds show an increase in relative reluctance with increasing flux.

Therefore, if we pass a magnetic-flux through a welded seam, in the same manner as for making magnetographs, but measure the magnetic-potential drop across the weld and also for the same distance in the parent metal, we have a weld test somewhat more quantitative than the magnetographic method. The method employed for laboratory tests is shown in the smaller cut. The same flux goes through the weld and the adjacent parent metal, hence the magnetic potential drop between any two points is proportional to the reluctance between those two points, and therefore is an indication of the quality of the weld.



Hand lamp makes a permanent magnetograph on blue-print paper of the pattern formed by the iron powder

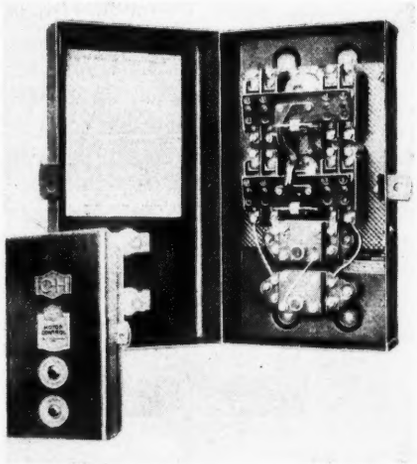
*Excerpts from paper presented at Fall Meeting of the American Welding Society, Chicago, Sept. 25.

WHAT'S NEW IN PLANT EQUIPMENT

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING, TRANSMITTING AND APPLYING THE POWER SERVICES

Automatic Starters for A.-C. Multi-Speed Motors

IN THE improved line of inclosed automatic starters for two-speed separate-winding-type squirrel-cage motors announced by Cutler-Hammer, Inc., 190-12th St., Milwaukee, Wis., three types are available, for starting on either winding, with sequence compelling feature or with automatic sequence control relay. For starting on either winding, depressing either the "low" or "high" button starts the motor on the respective "low" or "high" speed winding. The sequence compelling feature requires that the motor always be started at low speed before transferring to high speed. The automatic sequence control relay insures that the motor will always start at low speed and pass to high speed automatically if the "high" button is depressed. On all three types if the motor is operating at one speed it can be transferred to the other speed by simply depressing the other speed button. It is not necessary to stop the motor. A push-button master switch with "stop," "low" and "high" buttons is used to obtain control from a remote point.

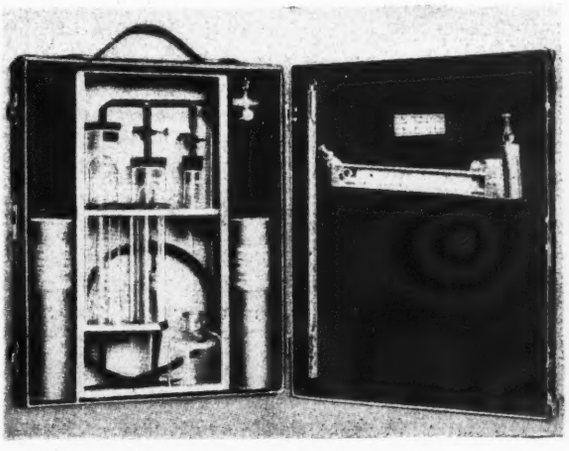


Starter with cover open

The mechanism, which consists of two magnetic contactors mechanically interlocked and two sets of thermal overload relays (one for each winding), is mounted in a split-type inclosing case which when opened provides easy access to the various operating parts.

Portable Combustion Test Set

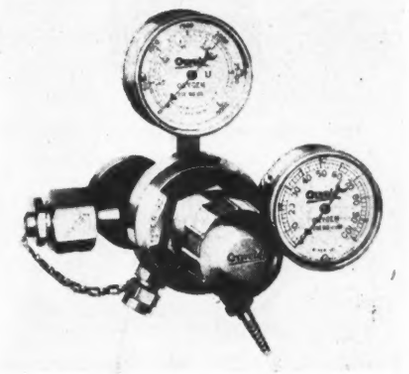
DESIGNATED model No. 00, the portable combustion test set illustrated is designed especially for checking combustion conditions on boilers using oil or gas as fuel. The draft gage shown mounted on the inside of the cover is a standard portable ½-in. gage. It can be used in position, or detached if desired. A flue gas thermometer graduated up to 1,000 deg. and fitted with a metal cover is also mounted on the cover. The Orsat, although securely mounted in the case, can readily be removed and hung on the wall or placed on a bench or other support. Dimensions of the carrying case are 15x12x5 in. The set is put out by the Defender Automatic Regulator Company, St. Louis, Mo.



Complete test set for oil- and gas-fired furnaces

Two-Stage Oxygen Regulator

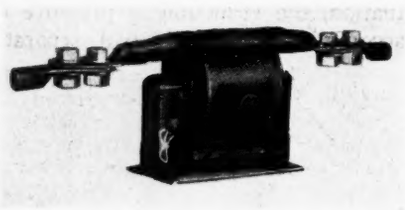
IN THE TYPE R-43 oxygen welding regulator designed to give a constant line pressure free from fluctuation, the reduction in pressure is accomplished through two separate and independent sets of diaphragms, valves and springs. The full cylinder pressure of 2,000 lb. enters the regulator through a stem-type valve and is controlled by the first-stage diaphragm. In this stage the pressure is reduced to less than 250 lb. per sq.in. The oxygen then passes from this first reduction assembly to a second stem-type valve and diaphragm assembly where the pressure is reduced to the working pressure desired by the operator. This pressure is regulated by the operator by means of an ad-



Type R-43 oxygen regulator

justing screw, and any operating pressure may be obtained.

In this new regulator instead of the usual handle-type pressure adjusting screw there has been substituted a screw with a ribbed cap. This change in external design in addition to giving a neater and more compact appearance also precludes the possibility of breakage as there are no projections on the handle to be bent accidentally. The regulator is put out by Oxweld Acetylene Company, 30 East 42nd St., New York City.



Instrument transformer type WF-1

Current Transformer for Instruments and Relays

BUILT in ratings from 5 to 800 amp. and designed for 5,000-volt operation, a new instrument current transformer announced by the General Electric Company, Schenectady, N. Y., embodies compensating features which practically eliminate ratio- and phase-angle errors. It is for use in connecting watthour meters, instruments and relays, the combined burden of which does not exceed 50 volt-amperes. The new transformer which is designated as WF-1, supersedes the WC-12 model with which it is interchangeable as to dimensions. It is arranged for either flat-surface or pipe mounting.

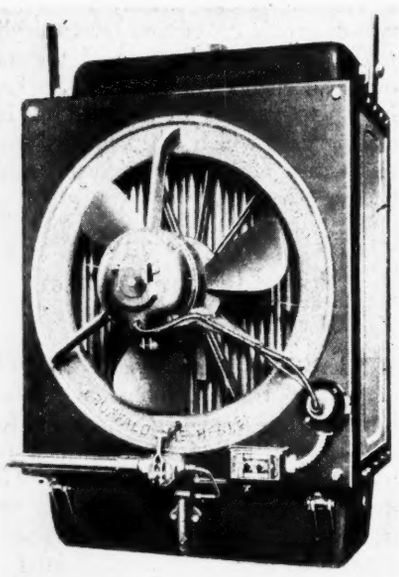
New Welding Electrodes

REDUCED METAL SPATTERING and a quiet, stable and flexible arc at both extreme low- and high-current values are claimed for the "Flex-Arc" welding electrode announced by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. These electrodes are said to have a uniform melting rate which assures quick penetration and the welds are easily machined and are free from slag, oxidation and gas inclusions. Tensile strengths ranging from 55,000 to 60,000 lb. per square inch are obtained.

Gas-Fired Unit Heater

DESIGNED especially for use where steam is not available and as a booster for existing heating systems, the new gas-fired unit heater put out by the Buffalo Forge Company, Buffalo, N. Y., is self-contained and is provided with full automatic control.

The heat interchanging element consists of brass tubes arranged in staggered rows. The heat from the gas burner is directed through the tubes and air is made to pass around them by means of a motor-driven fan mounted at the rear as shown. The gas burner consists of a series of tubes each with its own orifice mixer. This insures even distribution of gas to the burners. By means of an adjusting screw on the gas valve the amount of gas consumed can be readily controlled, a variation of 50,000 to 150,000 B.t.u. being made by this adjustment. The complete burner unit is contained in a metal combustion chamber at the bottom, which is hinged at the back and held in place at the front by three hand clamps. The pan with burner assembly can be dropped without making any break in the gas or electrical connections.



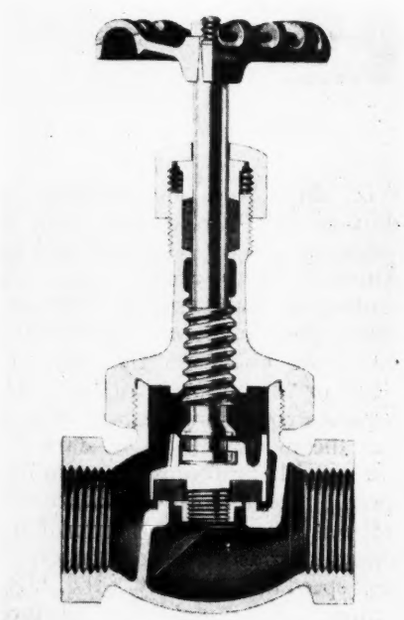
View of heater showing fan and automatic control

Among the safety features provided on the heater are safety pilot to shut off the motor and gas should the gas go out, an actuator which shuts off the gas should the motor current go off, a safety feature which shuts off motor and gas when the burner pan is lowered, and thermal overload protection on the motor switch. Maximum heat input of the unit is 150,000 B.t.u. an hour and the air delivery per minute 2,300 cubic feet.

Bronze Valve With One-Piece Bonnet and Slip-On Disk Holder

ONE-PIECE, screw-over bonnet and slip-on disk holder are features of a new line of standard bronze valves for 150-lb. steam working pressure or 250-lb. oil, water and gas pressure, brought out by Jenkins Brothers, 80 White St., New York City. The new line is made in globe, angle, cross and check types in flanged and screwed patterns, and in all standard pipe sizes from $\frac{1}{8}$ to 3 inches.

As will be apparent from the illustration an unusually deep stuffing box and long thread section for the stem are provided in the bonnet. When unscrewing the bonnet from the body of the valve the disk holder is retained on the stem by opening the valve a turn or two and can only be removed by screwing the stem in the opposite direction sufficiently to bring the disk holder below the bonnet nut. The valves are regularly fitted with Jenkins standard renewable composition disks for 150-lb. steam pressure. They can also be had with special disks for hot or cold water, gas, oil, and gasoline or specially fitted for other liquids.



Sectional view of bronze valve

NEWS of the FIELD

Spot News

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FOLLOWING *initial tests Oct. 2 of his plant to extract power from the temperature difference between the surface and bottom of the tropical sea near Matanzas, Cuba, Professor Georges Claude announced the results as "satisfactory for a first experiment." At 4,000 r.p.m. the steam turbines produced 10 kilowatts.*

•

THE DRIVE *to rid New York City of smoke got under way last week with 90 inspectors of the Health Department in co-operation with Col. Elliott H. Whitlock, former smoke commissioner of Cleveland, scouring the city for smoking plants. Thirty-nine summonses were served on violators of the city smoke ordinance, among which were steamship lines, hotels and power company plants.*

•

PLANT ATKINSON, *the largest single new source of electric power in Georgia since the completion of the Tallulah Falls hydro-electric development March 12, 1920, will be officially dedicated and placed in operation on Oct. 17. With an initial installation of 60,000 kw., the new plant will have an ultimate capacity of 100,000 horsepower.*

•

AN ORDER *amounting to approximately $500,000 and covering two pulverized coal fired 31,500-sq.ft. boiler units to be installed at a mine-mouth plant in Boncar, W. Va., has just been placed by the West Virginia Hydro-Electric Company with the Combustion Engineering Corporation. The boilers are of the high single-pass construction, designed to operate at 450 lb. pressure and 750 deg. F. temperature with a continuous output of 287,500 lb. of steam per hour.*

Compact and Flexible Pulverized-Coal Unit Installed on Steamship Lorain

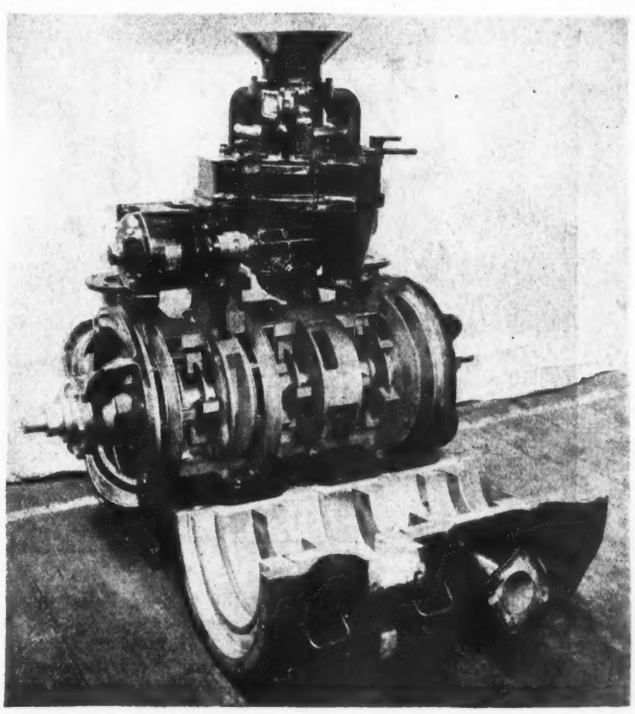
APPLICATIONS of pulverized coal to the marine field, both here and abroad, have attracted more than passing interest. The tests on various mills at the Philadelphia Navy Yard, and the pioneer installation on the steamship Mercer, more than two years ago, was the subject of several technical papers, and the subsequent performance of this vessel received wide publicity.

The Mercer, it will be recalled, was equipped with two ball mills, each serving one three-furnace Scotch boiler, the third, or middle, boiler being equipped to burn oil. One of the difficulties first encountered was the inability to secure proper three-way distribution to the individual burners. Several types of distributors were tried before a fairly satisfactory design was obtained.

The second pulverized coal installation was made by the Shipping Board on the steamship West Alsek. This represented an attempt to secure greater flexibility by having each furnace served by an independent high-speed mill. Each group of three mills (one group to a boiler) was driven by a steam turbine. The coal was fed to the mills by an overhead screw-feed system. While operating flexibility was thus obtained and the distribution problems surmounted, considerable space was taken up by this layout.

A refinement of this arrangement is represented by the installation on the steamship Lorain, built in 1919 but lately reconditioned by the Todd Shipyard Corporation. This 9,700-ton vessel is equipped with three, three-furnace boilers operating at 210 lb. pressure. She recently underwent a trial trip with pulverized coal and has been allocated by the Shipping Board to the Cosmopolitan Shipping Company, to be operated in North Atlantic trade, between New York and French ports. Instead of three mills per boiler, or nine in all, as on the West Alsek, each of the three boilers of the Lorain is served by one very compact triplex mill, driven direct by a 30-hp. steam turbine. The mill operates at 3,600 r.p.m., and has a capacity of 1,800 lb. per furnace. The photograph shows one of these mills as developed by the Erie City Iron Works,

Crushed coal from the service bin



One of the new pulverizing mills installed on the SS. Lorain. Unit is shown with cover removed and without driving turbine

falls directly into the mill hopper and is deposited on a revolving plate driven by the small direct-current motor shown. Adjustable knives scrape this coal off the plate into the respective channels leading into the three pulverizing elements of the mill. The coal feed is adjustable by means of the handwheel, shown near the top, which raises or lowers the feeding cone. Preheated primary air from the Howdon boiler fronts is led to the fan of each pulverizing element and the coal in suspension is conducted through flexible steel hose to the burners.

Coal is carried between decks, and grizzlies are fitted in the top of the service bin on the upper deck level so that small coal being led to the crusher, located just below, will fall by gravity into the service bin. The crusher has a capacity of 12 tons per hour, and has a tramp iron pocket. It is driven through a reduction gear by a 15-hp. steam turbine. There are no elevators or conveyors, as this arrangement permits the downward fall of coal throughout the process of bunkering, trimming and feeding to the pulverizers.

The burners are of the Todd combination oil- and pulverized-coal type. The oil heating and pumping equipment, used before conversion, has been left in place so that the ship will be able to take advantage of the cheapest available fuel, whether it be oil or coal.

While service records will not be available until after the vessel has made one or more trips, the performance on the trial run was satisfactory and there was a noticeable absence of smoke.

Power Commission Policy Set in Recent Decisions

The Federal Power Commission has just received from the Attorney General an opinion regarding the responsibility placed upon the commission under certain provisions of the federal water-power act relating to projects on non-navigable streams. The question at issue was the extent of the responsibility of the commission in issuing licenses for water-power projects within the several states and located on non-navigable tributaries of navigable waters where no government lands or reservations are involved. The purport of the Attorney General's finding is that in the character of cases under consideration the commission is not required to insert in a license any conditions (except the 50-year limitation upon the terms of the license) which, in its judgment, are not necessary or appropriate to fully utilize the waters of the tributary in the protection or development of navigation on the navigable waters into which such tributary empties.

Indications are that there will be no early departure from the present power commission policy of utilizing the engineering and accounting forces of the War, Interior and Agricultural departments. Those who are anxious to see the commission operate as economically as possible and who do not want to see duplication in the federal service are making their influence felt. It is fully expected that the new budget will make no provision whereby the new commission would be able to hire its own engineers and accountants. There is nothing in the reorganization act requiring any change of policy in this regard.

As now constituted the commission has been making every effort to confine itself to federal matters but it is not as easy as it would seem to keep out of situations which should be of state concern alone. Recently pressure has been brought from several directions on the commission to participate in the proceedings which have grown out of a rate fight in Crisp County, Ga. Certain interests in Georgia have insisted that Charles A. Russell, a solicitor in the commission's office, be sent to Georgia to take part in the hearings. The commission, however, is firm in its determination not to be a party to the controversy which has arisen in Georgia.

Pennsylvania Board Adopts New Boiler Regulation

The following regulation concerning water-tube boilers has recently been adopted by the Industrial Board of the Pennsylvania Department of Labor and Industry:

"A water-tube boiler shall have the firing doors, furnace inspection doors, and clinker doors of the inward opening type, unless such doors are provided with substantial and effective latching or fastening device of approved type or otherwise so constructed as to prevent them, when closed from being blown open by pressure on the furnace side. These latches or fastenings shall be of the automatic positive locking type having a latch or bolt in a fixed bracket on the door frame or furnace front. The latch or bolt shall be dependent upon gravity or be counterweighted. Friction contacts, latches or bolts actuated by springs are not acceptable. The material and construction of the device shall be durable and substantial. The foregoing requirement for latches or fastenings shall not apply to coal openings of downdraft or similar furnaces."

Materials Handling Meeting at Cleveland in 1931

Announcement is made of the second National Industrial Equipment Exposition to be held in Cleveland, Ohio, Apr. 13-18, 1931. The exposition will cover materials-handling equipment in its broadest sense including overhead, floor and underground conveyors, also trucks, tractors, cranes, hoists, and the varied equipment used in the industrial handling of materials and supplies in factories. The exposition will utilize the entire arena and exhibition hall of the Public Auditorium. The arena will include exhibits covering management and maintenance equipment as well as supplies and services of engineers and engineering companies interested in better production, time and labor saving

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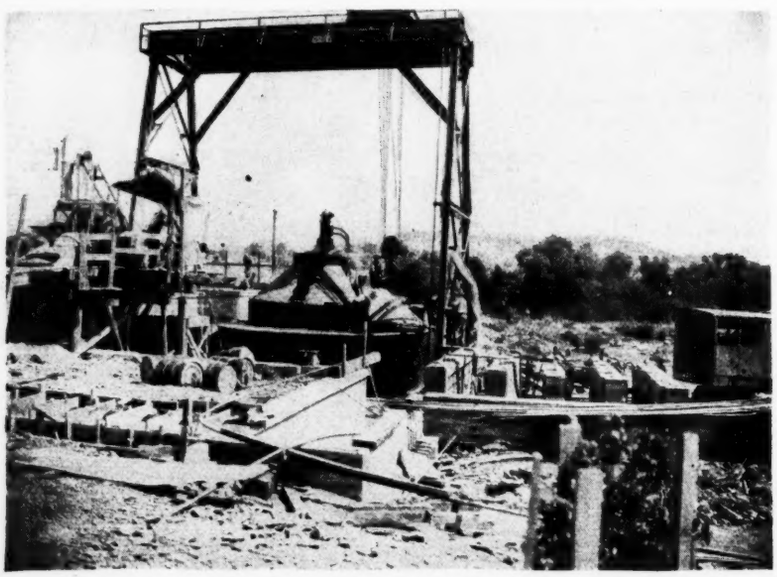
FIRST OUTDOOR UNIT IN CALIFORNIA



A 4,580-hp. outdoor generator at the Merced Falls plant of the San Joaquin Light & Power Corporation now replaces two 225-kw. Bullock units which have served for the past 27 years. Workmen are shown installing a 21-piece welded steel hood that protects the unit from the elements, the usual power house having been dispensed with in this, the first installation of its type in California

equipment, cost records, production control, better working and labor conditions, and management in every phase of industrial application.

During the same week will be held the fourth National Materials Handling Meeting of the American Society of Mechanical Engineers, as well as the second Industrial Congress on Management, Maintenance, and Materials Handling, which will be sponsored by the Management Division of the A.S.M.E., the Society of Industrial Engineers, and other national groups interested in progress in factory betterment. Over 25,000 members of these societies will give the congress broad possibilities for wide dissemination of knowledge in these fields.

New High-Pressure Turbines Ordered for Battleships

Incident to the modernization of the battleships Pennsylvania and Arizona, now undergoing extensive alterations and reconditioning by the Navy, the Westinghouse Electric & Manufacturing Company announces receipt of an order from the government for high-pressure and cruising turbines, with accompanying reduction gears, for installation in the vessels.

The cost of the new propulsion machinery will be approximately $500,000. In addition to the modernization of their machinery the big fighting ships, now more than fifteen years old, are being fitted with improved underwater defense, in the form of blisters, new fire-control equipment and other improvements, provided under the terms of the Washington Conference.

Seek Right to Distribute Natural Gas in Illinois

Authority to construct, operate and maintain natural gas distribution systems in seven central Illinois cities now being served with manufactured gas, is sought by the Panhandle Illinois Pipe Line Company in an amended application filed recently with the Illinois Commerce Commission. The cities to be supplied with natural gas are Peoria Pekin, Bartonville, East Peoria, Lincoln, Springfield and Bloomington.

In addition, the Panhandle company asks authority to construct and operate natural gas systems in 79 cities and villages where, according to the application, neither artificial nor natural gas is now available. The company also desires to serve consumers along the right of way of the pipe line which it proposes to construct across the state of Illinois from a point near Chrisman.

The applicant further seeks permission to sell natural gas to the Illinois Power & Light Corporation for its gas plants now serving the cities of Jacksonville, Decatur, Danville, Urbana, Champaign and Clinton.

A.S.M.E. Members Elect Officers for 1931

Officers elected by members of the American Society of Mechanical Engineers for the year 1931 were announced recently by the tellers of the election. The new officers are as follows: President — Roy V. Wright, managing editor of *Railway Age*, editor of *Railway Mechanical Engineer* and a former vice-president of the A.S.M.E.; Vice-presidents — William A. Hanley, chief engineer of Eli Lilly & Company, Indianapolis, Ind.; Thomas

Roy V. Wright

R. Weymouth, president of the Oklahoma Natural Gas Corporation, Tulsa; Harvey N. Davis, president of Stevens Institute of Technology, Hoboken, N. J.; Managers—W. L. Batt, president of SKF Industries, Inc., New York City; H. L. Doolittle, chief designing engineer of the Southern California Edison Company, Los Angeles; H. L. Whittemore, chief of the engineering mechanics section of the United States Bureau of Standards, Washington, D. C.

N.A.P.R.E. Convention at Memphis, Nov. 11-14

Preparations are going forward rapidly for the 21st annual convention and educational exhibition of the National Association of Practical Refrigerating Engineers, to be held in Memphis, Tenn., on Nov. 11 to 14 inclusive. Hotel Peabody has been chosen as convention headquarters and program arrangements are fast being completed.

Both the convention and exhibition will be held in the Memphis Auditorium, one of the largest municipal auditoriums in the country. A feature of the convention will be a 30-minute period at the beginning of each business session, which will be devoted to the discussion of practical subjects suggested by the delegates and visitors. Besides this many interesting papers and entertainment features will be included on the program, according to the committee in charge of arrangements.

News of Canada

Start Grand Lake Steam Plant — Contract for Seven Sisters-Winnipeg line—Plan extension to Winnipeg central heating system

IT IS EXPECTED that the new steam-electric power plant at Grand Lake, N. B., will be completed and in operation before the end of 1931. Excavation for the foundation of the plant is proceeding and construction of a railway siding is in progress. Most of the major items of equipment have been placed on order, and engineers are now busy on detailed plans for the plant. The machinery will be placed in the buildings during the winter.

The project represents the maturity of plans laid down last year by the New Brunswick Electric Power Commission whereby it proposed to establish a steam plant burning pulverized coal in the Grand Lake coal area. The mines in these coal fields are estimated to have a reserve of about 70,000,000 tons. It is hoped that operation of the new plant will replace imported coal and fuel oils with New Brunswick products. It has been pointed out that of the 633,000 tons of bituminous coal used in New Brunswick annually, about 450,000 tons are imported from outside the province.

A CONTRACT for the construction of a $1,000,000 double-circuit, steel-tower transmission line from Seven Sisters Falls to Winnipeg, in the province of Manitoba, has been let by the Northwestern Power Company to the Canadian Engineering & Construction Company, and work on the line will start immediately. The Northwestern company is an associate company of the Winnipeg Electric Company.

The transmission line will be 63 miles long and will transmit power at 110,000 volts into Winnipeg from the Seven Sisters Falls plant on the Winnipeg River. This line will suffice to convey the power from the initial installation of three machines of 37,500 hp. each, but a second similar line will be required when the three other machines are added, and the plant is installed to capacity, making the total production of the Seven Sisters plant 225,000 horsepower.

A FURTHER $1,000,000 extension to the city of Winnipeg's central heating system has been recommended by J. G. Glassco, manager of the Winnipeg Hydro-Electric System. The proposed extension of the steam heating plant would include a wide residential district. If proceeded with, $750,000 would be spent in 1931, this amount to include $400,000 for enlarging the steam-electric standby plant which supplies steam for heating and a feature of which is the utilization of off-peak electricity for this purpose. The remainder of the expenditure would be for extending the pipeline distribution system.

Trade Commission Resumes Public Utility Hearings

The Federal Trade Commission resumed hearings Sept. 29 in connection with its inquiry into the affairs of public utilities, as directed by the Senate resolution adopted on Feb. 27, 1928. The hearings were begun on March 8, 1928, and the last recess was taken on June 25 of this year.

During the past week Robert J. Ryder and Carl H. Depue, accountants of the economic division of the commission, described details of the transactions by which the Carolina Power & Light Company was formed, and its status in relation to its parent corporation, the National Power & Light Company. Inflation of assets, failure to segregate such inflation from fixed capital assets which are used for rate making purposes, and the lack of adequate retirement reserves for depreciation and obsolescence by the Carolina company were disclosed by their testimony.

Natural Gas for Butte

Application for a franchise to serve Butte, Mont., with natural gas has been filed with the city council by the Montana Power Company. Under the plans announced by Frank M. Kerr, vice-president and general manager, the company would construct a pipe line from the Montana fields at an approximate cost of $12,000,000 to $15,000,000 to carry the gas to Butte and Anaconda. In asking that the company's petition for franchise be submitted to the voters Mr. Kerr stated that approximately $1,500,000 would be spent in Butte. The matter is at present in the hands of the judiciary committee of the Butte City Council, and is expected to be presented to the voters by the middle of November.

Oppose Dill Patent Bill as Unfair Anti-Trust Law

In the Dill bill proposing to suspend patent rights when the holder is violating the anti-trust statutes is seen the most extreme anti-trust legislation yet proposed. By suspending returns from patents, or by creating uncertainty as to their ultimate value, penalties under the Dill bill would run enormously higher, in some instances, than any penalty provided by the Clayton act.

While this measure was passed by the Senate at the last session of Congress, before its far-reaching possibilities were appreciated by most of the members of that body, the measure was recalled from the House and will face strong opposition when it is taken up at the December session.

The measure proposes that anyone sued for infringement of patent has a complete defense if he can prove that the patent owner is violating any of the anti-trust statutes. The bill provides further that the anti-trust case must be tried in advance of the patent infringemen case. Some interpret this to mean that patent infringement can continue throughout the period of the anti-trust litigation. It is foreseen that this might cover an extended period, and affords a chance for unfair practices.

Coming Conventions

American Society of Mechanical Engineers. Fall meeting at French Lick Springs, Ind., Oct. 13-17. National Wood Industries Division. Meeting at the Hotel Pennsylvania, New York City, Oct. 16-17. National Petroleum. Annual meeting in New York City, Dec. 1-5. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Engineering Council. Administrative board meeting at the Mayflower Hotel, Washington, D. C., Oct. 17-18. Secretary, L. W. Wallace, 26 Jackson Pl., Washington, D. C.

American Institute of Electrical Engineers. District meeting at Philadelphia, Pa., Oct. 13-15. District meeting at Louisville, Ky., Nov. 19-22. Annual Winter convention in New York City, Jan. 26-30, 1931. Secretary, F. L. Hutchinson, 33 West 39th St., New York City.

American Society of Refrigerating Engineers. Annual meeting at the Hotel New Yorker, New York City, Dec. 3-6. Secretary, David L. Fiske, 37 West 39th St., New York City.

Midwest Power Engineering Conference and Exposition. Fifth meeting in Chicago, Ill., Feb. 10-13, 1931. Secretary, George E. Pfisterer, 308 West Washington St., Chicago, Ill.

National Association of Practical Refrigerating Engineers. Annual convention and exhibition at the Hotel Peabody, Memphis, Tenn., Nov. 11-14. Secretary, Edward H. Fox, 5707 West Lake St., Chicago, Ill.

National Power Show. Grand Central Palace, New York City, Dec. 1-6. Manager, Charles F. Roth, Grand Central Palace, New York City.

Society of Industrial Engineers. Seventeenth national convention at the Mayflower Hotel, Washington, D. C., Oct. 15-17. Secretary, George C. Dent, 205 West Wacker Drive, Chicago, Ill.

Stoker Manufacturers Association. Fall meeting at the Homestead, Hot Springs, Va., Nov. 3-5. Secretary, William V. McAllister, Foot of Walker St., Detroit, Mich.

State Line Changes Name

By an amendment to its articles of incorporation which became effective recently the name of the State Line Generating Company, whose plant at Hammond, Ind., furnishes energy to four large Insull operating companies, was changed to Chicago District Electric Generating Company.

Personals

T. V. Whittier, for the past thirteen years with the Blackstone Valley Gas & Electric Company, first as chief engineer and later as superintendent of power, has joined the Stone & Webster Engineering Corporation as engineer in the power division. At present he is in Baton Rouge in connection with the operation of the Louisiana Station of Louisiana Steam Products, Inc. Mr. Whittier has been associated with the Stone & Webster organization for 23 years, during which time he has worked for Tampa Electric Company, Houghton County Electric Company and Blackstone Valley Gas & Electric Company.

E. V. Ahara, formerly with the Ruths Steam Storage Company, Toronto, Ont., is now connected with the Abitibi Power & Paper Company, of Toronto. Mr. Ahara was at one time mechanical engineer with the Combustion Engineering Corporation, Toronto.

T. A. Burdick, formerly chief engineer of the General Water Works & Electric Corporation at Fort Worth, Texas, is now associated with the Nuway Tool Corporation of New York City.

John S. Paige, formerly chief engineer of the Paige & Jones Chemical Company of Hammond, Ind., has become associated with the Steel Tank & Products Corporation of Chicago, as technical director.

T. B. Nussey has recently joined the Stone & Webster Engineering Corporation at its Boston office as engineer in the appraisal division. Previous to this connection Mr. Nussey has been associated with Jackson & Moreland, Forestall-Robinson & Luqueer, and the Long Construction Company.

Douglas MacArthur, engineer, has just been appointed chief of the general staff of the United States Army. This is the first time since its creation in 1903 that an engineer has been chosen for that important position. General MacArthur's tour of duty begins this month on his return from the Far East where he has been in command of the Philippine department.

William Deans, formerly chief engineer of the Sundh Electric Company of Newark, N. J., has been appointed general manager of the company. Mr. Deans has been connected with the organization since 1918, in charge of engineering, including design, development and experimental work.

H. R. Williams, formerly connected with the A. P. Green Fire Brick Company, is now associated with the Mexico Refractories Company as representative in the State of Indiana, southwestern Ohio and Kentucky. Mr. Williams has established headquarters at 1701 North Illinois St., Indianapolis.

Business Notes

AMERICAN PROPELLER COMPANY, Baltimore, Md., announces the appointment of E. M. Lacey, 25 West Broadway, New York City, as factory representative in New York and in the territory from Bridgeport, Conn., to Camden, N. J.

WILLIAMS GAUGE COMPANY, N. S. Pittsburgh, Pa., has recently appointed the following new sales agents: John G. Bell Company, 712 East 6th St., Los Angeles, Calif.; R. J. Crozier Company, 10 South 18th St., Philadelphia, Pa.; Republic Supply Company, 332 Continental Oil Bldg., Denver, Colo.; Russell S. Harris, 1105 Maritime Bldg., New Orleans, La.; McLean-Peterson Company, Blymyer Bldg., 514 Main St., Cincinnati, Ohio; Ballweber Engineering Company, Blymyer Bldg., 514 Main St., Cincinnati, Ohio.

STRIEGEL & JEFFERSON, Inc., of New York City, is a partnership recently formed by Edward H. Striegel and E. R. Jefferson. With offices at 5 Beekman Street, the new firm will represent the Drake Non-Clinkering Furnace Block Company of New York City and King Refractories Company of Buffalo, N. Y. Mr Striegel was formerly with the Furnace Engineering Company and the Union Iron Works, while Mr. Jefferson has been associated with the Bernitz Furnace Appliance Company for the past eleven years.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, East Pittsburgh, Pa., announces the appointment of L. B. Mead as assistant industrial manager of the Northwest district of the company, and the appointment of William J. Morgan as Indianapolis manager.

BERNITZ FURNACE APPLIANCE COMPANY, Boston, Mass., announces the appointment of Fred G. Schneeberg, Jr., to succeed E. R. Jefferson as district sales manager of the company's New York office, located at 350 Madison Avenue.

ALLEN-BRADLEY COMPANY, New York City, announces the addition to its New York sales staff of C. H. Ribble, formerly in charge of the New York office of the Industrial Controller Company, and George Breuer, formerly with the General Electric Company. H. J. Staib, formerly connected with the Century Electric Company, has joined the sales staff of Allen-Bradley's Cincinnati office.

E. K. STRAHAN, INC., New Orleans, La., has moved its office from 310 Pere Marquette Building to 816 Howard Avenue.

CUTLER-HAMMER, INC., Milwaukee, Wis., announces the removal of its Philadelphia sales office to the tenth floor of the new Terminal Commerce Building, 401 North Broad St. These new quarters also include warehouse facilities.

How's Business?

THOUGH still disappointing in its speed, gradual improvement in the general level of business activity continues, at slightly more than the seasonal rate. Our preliminary index for the week ended September 27 shows a further slow rise from 85.8% of normal to 86%. The seasonal rise in industrial activity is still irregular and uncertain, but in general trade and in building it is more definite. Further improvement during October is fairly certain, but, without a sudden and decisive change in business psychology and banking policy, it is difficult to see from what source to expect trade to gather sufficient momentum in the next six weeks to carry us through the winter onto higher and firmer ground next year. The economic aborigines and puritan fathers who like long winters will enjoy this one.—*The Business Week*, Oct. 8.

Trade Catalogs

COMPRESSORS AND PUMPS—Bulletin AC-7100, rotary compressors and dry vacuum pumps, Yeomans Brothers Company, 1433 Dayton St., Chicago, Ill.

WIRING DEVICES—Bulletin H-2, terminal blocks, Burke Electric Company, Erie, Pa.

VALVES — Bulletin 141, standard bronze valves, Jenkins Brothers, 80 White St., New York City.

HEATERS—Bulletin No. 2754, gas unit heaters, Buffalo Forge Company, Buffalo, N. Y.

STEEL FORGINGS—Bulletin No. 17, nickel-alloy steel forgings data and applications, The International Nickel Company, Inc., 67 Wall St., New York City.

COAL HANDLING—Bulletin No. 510, Flextooth crusher, Jeffrey Manufacturing Company, Columbus, Ohio.

CONTROL INSTRUMENTS — Catalog 4000, air-operated controller equipment, The Bristol Company, Waterbury, Conn.

INSTRUMENTS — Catalog No. 15-A, pyrometers, The Brown Instrument Company, Wayne and Roberts Aves., Philadelphia, Pa.

VALVES — Bulletin No. 167, V-port controlled valves, The Foxboro Company, Foxboro, Mass.

MOTORS — Leaflet 2124, totally-enclosed, fan-cooled induction motors, Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

INSTRUMENTS—Bulletin 262, engine indicators, Maihak type, Bacharach Instrument Company, 7000 Bennett St., Pittsburgh, Pa.

WELDING—Bulletins No. 2002, Rowland process forge welded containers; No. 3003, Rowland process forge welded storage tanks; American Welding Company, 30 Church St., New York City.

INSTRUMENTS — Catalog, "Indicators and Accessories for Steam and Diesel Engines," Dobbie McInnes & Clyde, Ltd., 57 Bothwell St., Glasgow, Scotland.

Fuel Prices

FUEL OIL

Coal Age Quotations

New York—Oct. 2, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.75c.@5.25c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, 6c.@6.25c. per gal.

St. Louis—Sept. 23, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.345 per bbl., or 42 gal.; 26@28 deg., $1.445 per bbl.; 28@30 deg., $1.545 per bbl.; 30@32 deg., $1.652 per bbl.; 32@36 deg., gas oil, 4.026c. per gal.; 38@40 deg., distillate, 4.651c. per gal.

Pittsburgh — Sept. 30, f.o.b. local refinery, 34@36 deg., fuel oil, 3.5c. per gal.; 36@40 deg., 3.5c.

Philadelphia — Oct. 1, 13@19 deg., $1.05@$1.10 per bbl. or 42 gal.; 18 deg. plus, $1.475@$1.525 per bbl.; 23@27 deg., $2.00@$2.05 per bbl.

Cincinnati — Sept. 23, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5.25c. per gal.; 26@30 deg., 5.5c. per gal.; 30@32 deg., 5.75c. per gal.

Chicago—Sept. 30, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 60c. per bbl.; 26@30 deg., 75c. per bbl.; 30@32 deg., 87.5c. per bbl.

Boston—Sept. 29, tank-car lots, f.o.b., 12@14 deg., Baumé, 3.5c. per gal.; 28@32 deg., 5.1c. per gal.

Dallas—Sept. 27, f.o.b. local refinery 26@30 deg., $1.10 per bbl. or 42 gallons.

COAL

Bituminous (Net Tons)	At Mine, for Shipment to	Price per Ton
Pool 9, super low-vol.	New York	$1.85 @ $2.10
Pool 10, hr.gr. low-vol	New York	1.65 @ 1.90
Pool 11, low-vol	New York	1.50 @ 1.75
Smokeless, mine run	Chicago	1.75 @ 2.00
Smokeless slack	Chicago	.70 @ 1.25
S. E. Ky. slack	Chicago	.90 @ 1.00
Franklin, Ill. mine run	Chicago	2.15
Franklin, Ill. screenings	Chicago	1.35 @ 1.60
Ind. 5th Vein lump	Chicago	1.75 @ 2.25
Standard Ill. lump	St. Louis	1.65 @ 2.00
W. Ky. mine run	Louisville	.85 @ 1.25
W. Ky. slack	Louisville	.35 @ .60
Pittsburgh mine run	Pittsburgh	1.30 @ 1.60
Smokeless, mine run	Cincinnati	1.85 @ 2.00
Smokeless slack	Cincinnati	.75 @ 1.35
Kanawha, mine run	Cincinnati	1.10 @ 1.35
Kanawha, slack	Cincinnati	.85 @ 1.00

Anthracite (Gross Tons)	At Mine, for Shipment to	Price per Ton
Buckwheat	New York	$3.00@3.50
Barley	New York	1.25 @ 1.50

New Plant Construction

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Ala., Montgomery—Alaga Syrup Co., L. B. Whitfield, Pres., North Court St., will soon award contract for the construction of a 2 story cold storage plant. Estimated cost $30,000.

Arizona—Electric Bond & Share Co., H. S. Aller, V. Pres., 2 Rector St., New York, N. Y., is having preliminary surveys made for the construction of a power development on Salt River above Roosevelt dam here, 150,000 hp. total capacity. Estimated cost $3,000,000. C. L. Ager, c/o owner, is engineer.

Calif., Los Angeles—City plans an election Nov. 4, to vote $13,300,000 bonds to augment and improve power facilities at Owens Valley water and power system; survey and acquisition for a power transmission line from Boulder dam to Los Angeles.

Calif., Modesto — County of Stanislaus, awarded contract for the construction of a power plant as third unit of County Hospital project to M. O. Ward, 222 Magnolia St.

Conn., Hartford—Bd. of Contract & Supply, had plans prepared for the construction of a pumping station at South Meadows to prevent flooding. Estimated cost $145,000. R. Clark, City Hall, is engineer.

Ind., Butlerville—Feeble Minded School, received lowest bid for the construction of a power plant and equipment from Miles Cutshall, Akron. Estimated cost $50,000. O. B. Little, 307 North Illinois St., Indianapolis, is engineer.

Ia., Ames—City, A. B. Maxwell, Clk., will soon award contract for a sanitary sewage system including wet well, pumping station, centrifugal pump, etc.

Kan., Holton — City, J. A. Pomeroy, Clk., awarded contract for additions and alterations to present municipal power plant, including cement foundation for new oil engine to J. Strohwig, Holton, $15,627.

Mass., Boston—Edison Electric Illuminating Co., 39 Boylston St., awarded contract for addition to power plant to Babcock-Davis Corp., 474 Dorchester Ave., South Boston. Estimated cost exceed $40,000.

Mass., Everett—Boston Consolidated Gas Co., 250 Stuart St., Boston, awarded contract for a 1 story switch house here to Long Construction Co., 185 Devonshire St., Boston

Mass., Natick—J. A. Hill, 90 Pond St., will soon award for the construction of an artificial ice plant on West Central St. Estimated cost $75,000. C. Coneby Engineering & Construction Co., 1580 Ansol Rd., Cleveland, O., are engineers.

Mass., Weymouth—Weymouth Light & Power Co., 1371 Commercial St., awarded contract for the construction of a power sub-station to Clark & Smith, 13 Temple St., Quincy. Estimated cost $40,000.

Miss., Newton — Southern United Ice Co., Jackson, plans the construction of a 1 story ice plant here. Estimated cost $20,000.

Mo., University City—St. Louis County Water Co., 6600 Delmar Blvd., is having preliminary plans prepared for waterworks system including high pressure pumping station, pumping equipment, etc. Estimated cost $2,000,000. Private plans.

N. J., Newton—Town Committee, A. Vough, Clk., will receive bids until Oct. 14, for the construction of a pumping station, etc. T. F. Bowe, 110 William St., New York, N. Y., is consulting engineer.

N. Y., Auburn — Dept. of Correction, State Capitol, Albany, will soon receive bids for the construction of a new power plant, foundry shop, stores building, etc., at Auburn Prison here.

N. Y., Brooklyn—Brooklyn Edison Co., 380 Pearl St., awarded contract for superheaters in connection with steam power plant to Superheater Co., 60 East 42nd St., New York. Estimated cost exceed $250,000.

N. Y., Long Beach — Knickerbocker Ice Co., 41 East 42nd St., New York, will receive bids about Oct. 20, for the construction of an ice plant, here. Estimated cost $30,000.

O., Conneaut—City will receive bids about Oct. 27 for extensions and improvements to waterworks, including pumping station, reservoir, mains, etc. Estimated cost $75,000. Brown-Morgan Engineering Co., Lorain, is engineer.

Ore., Hood River—City Council, awarded contract for a hydro-electric power plant and distribution system to J. C. Roberts, Spokane, Wash., $25,985; power house to Apple City Electric Co., Hood River, and generator to Pelton Water Wheel Co., 2929 19th St., San Francisco, Calif. Total estimated cost $33,156.

Pa., Bellevernon—West Penn Power Co., 18 Wood St., Pittsburgh, will build a 1 story substation here. Estimated cost $25,000. Sanderson & Porter, 52 William St., New York, are engineers. Work will be done by separate contracts.

R. I., Melville—Bureau of Yards & Docks, Navy Dept., Washington, D. C., awarded contract for power plant equipment to Industrial Heating & Engineering Co., 490 Broadway, New York.

Tex., Port—City is having plans prepared for the construction of a central water pumping plant. J. B. Converse & Co., Port Arthur, are engineers.

Tex., San Antonio—City is receiving bids for remodeling of and alterations to old market house including refrigerating unit, etc. Estimated cost $30,000. I. Ewing, City Hall, is engineer.

Tex., Schertz — U. S. Government, c/o A. W. Parker, Constructing Quartermaster, San Antonio, will receive bids until Oct. 20, for the construction of a post exchange building including refrigeration unit at Randolph Field, 14 mi. north of San Antonio. Estimated cost $50,000. R. Kelly, 336 Milan Bldg., San Antonio, is architect and engineer.

Wash., Wenatchee — Howard Flat District, voted $300,000 bonds for the construction of an electric pumping plant in connection with irrigation project. W. T. Batcheller, Dexter Horton Bldg., Seattle, is engineer.

W. Va., Boncar—West Virginia Hydro-Electric Co., subsidiary of Union Carbide & Carbon Co., 30 East 42nd St., New York, N. Y., awarded contract for boilers, furnaces and pulverized fuel burning equipment for plant here, to Combustion Engineering Corp., 200 Madison Ave., New York. Estimated cost $500,000.

Ont., St. Thomas—City, plans remodeling and enlarging water filtration plants, including filters, pumps, etc. Estimated cost $95,000. Work will be done by day labor under the supervision of W. C. Miller, City Hall, Engr.

Ont., Toronto—Yolles & Rotenberg, 372 Bay St., plans the construction of a 20 story office building including steam heating system, etc. Estimated cost $600,000. Chapman & Oxley, Sterling Tower, are architects. Owner will probably proceed with about 6 story by day labor.

Equipment Wanted

Boiler — Washington, D. C. — Constructing Quartermaster, Army Medical Center, will receive bids until Oct. 28, for additional boiler installation in heating plant.

Generator—Brooklyn, N. Y.—Signal Supply Officer, New York General Depot, 58th St. and First Ave., will receive bids until Oct. 28, for fifteen electric generators giving 200 v. d.c.

Ice Plant Machinery—Denton, Tex.—City will receive bids until Oct. 10, for the installation of machinery in municipal ice plant. Estimated cost $50,000.

Pump—Toronto, Ont.—City will soon receive bids for replacement of 7½ m.g.p.d. centrifugal pump at high level pumping station.

Pump and Electrical Equipment — Trenton, N. J.—City will readvertise for bids for pump and electrical equipment for waterworks pumping station.

Pump and Motor—Stratford, Calif.—Stratford Public Utility Dist., will receive bids about Oct. 14 for pump and motor, etc., for proposed waterworks. Estimated cost $28,000.

Pump and Motor—Idaho—Bureau of Reclamation, Denver, Colo., will receive bids until Oct. 31, for pump having a capacity of 180 second feet when operating under a total effective head of 31 ft., one 800 hp., 2,200 v., 3 ph., 60 cycle, synchronous motor and auxiliary control apparatus for pumping station No. 1, Minidoka Project, here.

Pumps—Lodi, N. J.—Bd. of Council, Boro Hall, plans the installation of air lift pumps at wells 5, 6 and 7, in connection with waterworks.

Pumps—Mt. Vernon, Wash.—City will receive bids about Oct. 4, for pumps, etc., in connection with sewage treatment work. Estimated cost $110,000.

Industrial Projects

Calif., Emeryville — Furniture Corp. of America, H. A. Green, Pres., c/o Doernbecher Mfg. Co., East 28th St. N., Portland, Ore., plans the construction of a furniture factory here. Estimated cost $250,000. Architect not selected.

Calif., Los Angeles—Baker Oil Tools, Inc., 2959 East Slauson St., Huntington Park, awarded contract for a 1 story, 65 x 577 ft. factory, first unit 68 x 118 ft. to Brownell Construction Co., 2528 Slauson Ave., Huntington Park. Estimated cost $125,000.

Conn., Danbury — Concannon Shear Co., is having plans prepared for the construction of a 2 story, 40 x 150 ft. factory. Estimated cost $45,000. Private plans.

Conn., New Britain—Eastern Malleable Iron Co., 62 John St., will soon award contract for a 2 story addition to factory. Estimated cost $40,000. M. Unklebach, 52 Main St., is architect.

Me., Waterville — Hollingsworth & Whitney Co., Gardner, will build a 1 story addition to boiler house. Estimated cost $40,000. C. T. Main Inc., 201 Devonshire St., Boston, are engineers. Work will be done by day labor.

Mass., Dorchester (Boston P. O.)—Thompson Wire Co., 43 Mildred Ave., awarded contract for the construction of a 1 story manufacturing building to Clark & Smith, 13 Temple St., Quincy. Estimated cost $40,000.

Mass., Fitchburg—Simonds Saw & Steel Co., 55 North St., awarded contract for the construction of a 360 x 550 ft. manufacturing plant, to The Austin Co., 120 Broadway, New York. Estimated cost $1,500,000.

Mich., Dearborn — U. S. Tool & Mfg. Co., Detroit, awarded contract for the design and construction of a 1 and 2 story, 100 x 200 ft. plant for the manufacture of precision tools on Kingsley St. here, to The Austin Co., 16112 Euclid Ave., Cleveland, O.

Mich., Detroit — Ex-Cell-O Aircraft & Tool Corp., 5835 Martin Ave., awarded contract for the design and construction of a 1 story, 53 x 190 ft. factory to The Austin Co., 16112 Euclid Ave., Cleveland, O. Estimated cost $150,000.

N. J., Newark—Weldron Roberts Rubber Co., 18 Oliver St., is having plans prepared for the construction of a 2 story addition to factory at 361-65 6th Ave. Estimated cost $40,000. M. N. Shoemaker, 10 Bleecker St., is architect.

N. Y., Buffalo — Ford Motor Co., 3674 Schaefer Rd., Dearborn, Mich., awarded contract for a 1 and 2 story, 420 x 1,000 ft. assembly plant including machine shop, combination boiler house and power plant, etc. here, to Hunkin-Conkey Construction Co., Newman-Stern Bldg., Cleveland. Estimated cost $750,000.

O., Wickliffe—Cleveland Crane & Engineering Co., H. Karr, Purch. Agt., awarded contract for a 1 story addition to factory to The Austin Co., 16112 Euclid Ave., Cleveland. Estimated cost $40,000.

Pa., Neville Island—Gulf Refining Co., Frick Bldg., Pittsburgh, awarded contract for the construction of boiler house to Hughes Foulkrod Co., 7th Ave., Pittsburgh. Also will soon award contract for third unit consisting of transfer pump house, treating plant pump house, accumulator building, compressor building, hot oil pump building, casing head pump house, acid concentrator building, caustic plant, dye house, dye, sulphur and clay storage. Estimated total cost $1,500,000.

Tex., Houston — Sinclair Refining Co., 45 Nassau St., New York, N. Y., will build a refinery and transport facilities at Houston Ship Channel here. Estimated cost $2,000,000. Private plans. Work will be done by day labor and separate contracts.

Tex., Temple—Texas & Pacific Coal & Oil Co., plans the construction of a refinery for gasoline and oil by-products. Estimated cost $500,000.

W. V., Clarksburg—Weirton Steel Co., J. C. Williams, Pres., plans complete electrification of tin plate plant. Estimated cost $250,000.

Ont., Cornwall—Courtauld's Canada Ltd., is having plans prepared for the construction of a rayon silk factory. Estimated cost $500,000. Private plans.

Ont., Hamilton—Canada Iron Foundries, Ltd. Stuart St., awarded contract for the construction of a 1 story, 90 x 140 ft. casting plant and pattern shop to W. H. Cooper, Lister Bldg. Estimated cost $50,000.